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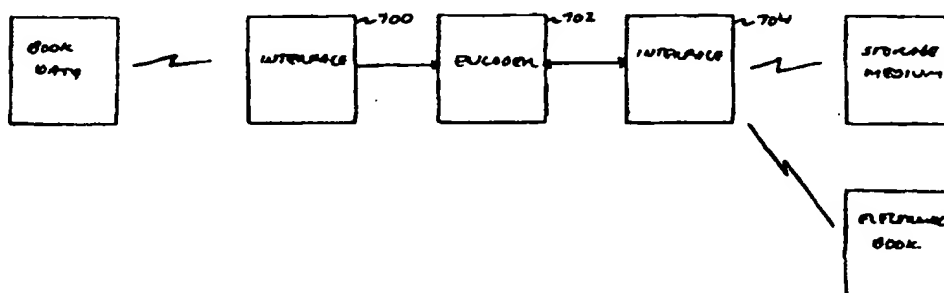
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>G06F 17/22</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 97/22067</b> <b>(43) International Publication Date:</b> 19 June 1997 (19.06.97)
<b>(21) International Application Number:</b> PCT/US96/19701 <b>(22) International Filing Date:</b> 11 December 1996 (11.12.96) <b>(30) Priority Data:</b> 08/572,468 14 December 1995 (14.12.95) US <b>(71) Applicant:</b> MOTOROLA INC. [US/US]: 1303 East Algonquin Road, Schaumburg, IL 60196 (US). <b>(72) Inventors:</b> HUFFMAN, James, R.; 4 Stegner Lane, Austin, TX 78746 (US). JAMBHEKAR, Shrirang, N.; 1810 Hemlock Place #310, Schaumburg, IL 60196 (US). <b>(74) Agents:</b> INGRASSIA, Vincent, B. et al.; Motorola Inc., Intellectual Property Dept., P.O. Box 10219, Scottsdale, AZ 85271-0219 (US).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** METHOD AND SYSTEM FOR ENCODING A BOOK FOR READING USING AN ELECTRONIC BOOK



**(57) Abstract**

A method and system for encoding a book for reading by an electronic book having an internal machine-readable dictionary includes receiving data representative of text and graphical information of the book. The system includes an encoder (702) in communication with interface (700) for encoding first machine-readable data representative of a plurality of words not included in the internal machine-readable dictionary to provide a customized dictionary. The encoder (702) also encodes data representative of the text in the book and data for modifying a spoken auditory display of the text using the voice synthesizer (162). The encoder (702) is in communication with interface (704) for communicating these data to the electronic book.

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METHOD AND SYSTEM FOR ENCODING  
A BOOK FOR READING USING AN ELECTRONIC BOOK

Related Invention

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The present invention is related to the following invention which is assigned to the same assignee as the present invention:

"System and Method for Limiting Access to a Book Card", having Serial No. 08/572,346, filed December 14, 1995.

10

"Apparatus and Method for Storing and Presenting Text", having Serial No. 08/572,451, filed December 14, 1995.

"Method and Electronic Book for Creating a Plurality of Versions of a Book", having Serial No. 08/572,485, filed December 14, 1995.

15

"Electronic Book Diary and Method For Use Therefore", having Serial No. 08/572,602, filed December 14, 1995.

"Method and Device for Inhibiting the Operation of an Electronic Device During Take-Off and Landing of an Aircraft", having Serial No. 08/572,603, filed December 14, 1995.

20

"System for Inhibiting the Operation of an Electronic Device During Take-Off and Landing of an Aircraft", having Serial No. 08/572,484, filed December 14, 1995.

"Method for Abridging Text", having Serial No.

25

08/572,834, filed December 14, 1995.

"A Method of Substituting Names in an Electronic Book", having Serial No. 08/572,480, filed December 14, 1995.

"System and Method of Authoring Tools for an Electronic Book", having Serial No. 08/572,358, filed December 14, 1995.

30

"System and Method for an Automatic Library for a Plurality of Book Cards", having Serial No. 08/572,482, filed December 14, 1995.

- 0        "Electronic Book and Method of Selecting a Primary Font  
and a Primary Size for Displaying Text Therewith", having  
Serial No. 08/572,407, filed December 14, 1995.
- "Electronic Book and Graphical User Interface for  
Selecting a Book to Read Therewith", having Serial No.  
5    08/572,406, filed December 14, 1995.
- "Electronic Book and Graphical User Interface to  
Provide Control Thereof", having Serial No. 08/572,403,  
filed December 14, 1995.
- "Electronic Book and Method of Storing at Least One  
10    Book in an Internal Machine-Readable Storage Medium", having  
Serial No. 08/572,593, filed December 14, 1995.
- "Electronic Book and Method of Annotation Therefor",  
having Serial No. 08/572,367, filed December 14, 1995.
- "Electronic Book and a Method of Displaying a Relative  
15    Position of a Current Page of a Book Therefor", having  
Serial No. 08/572,373, filed December 14, 1995.
- "Electronic Book and Method of Displaying an Animated  
Page Turn Therefor", having Serial No. 08/572,405, filed  
December 14, 1995.
- 20        "Electronic Book and Method of Controlling a Rate of  
Information Displayed Thereby", having Serial No.  
08/572,372, filed December 14, 1995.
- "Reusable Housing and Memory Card Therefor", having  
Serial No. 08/572,413, filed December 14, 1995.
- 25        "Electronic Book and Method of Displaying at Least One  
Reading Metric Therefor", having Serial No. 08/572,842,  
filed December 14, 1995.
- "Electronic Book and Method of Creating a Personal Log  
of Reading Activity Therefor", having Serial No. 08/572,456,  
30    filed December 14, 1995.
- "Electronic Book Having Highlighting Feature", having  
Serial No. 08/572,469, filed December 14, 1995.
- "Electronic Book and Method of Capturing and Storing a  
Quote Therein", having Serial No. 08/572,601, filed December  
35    14, 1995.

0       The subject matter of the above-identified related  
inventions are hereby incorporated by reference into the  
disclosure of this invention.

#### Field of the Invention

5       The present invention relates to methods and systems  
for encoding textual and graphical information in a book for  
reading using an electronic book.

#### 10                   Background of the Invention

Various types of hand-held electronic reading devices  
have been proposed to electronically display textual  
information for reading by a user. A typical hand-held  
15   electronic reading device includes a display device to  
display the textual information and a user interface which  
allows a user to navigate through the textual information  
and access various features of the electronic reading  
device. The display device and the user interface are  
20   incorporated in a hand-held housing to facilitate  
portability of the electronic reading device.

Many hand-held electronic reading devices have a user  
interface in the form one or more external buttons. The  
buttons are depressed in a predetermined manner either to  
25   navigate through the textual information or to access  
various features of the device. However, many hand-held  
electronic reading devices implement the user interface in a  
manner which does not provide a simple, intuitive, or  
efficient method for navigating the textual information or  
30   for accessing the features.

The lack of simplicity of using current hand-held  
electronic reading devices along with the lack of comfort in  
handling many of these devices result in some people  
preferring to read a real paper book rather than using a  
35   hand-held electronic reading device.

0       The textual information displayed by the hand-held  
electronic reading device is typically stored in a memory  
device or the like. U.S. Patent No. 5,239,665 to Tsuchiya  
discloses an electronic book having an interface which  
receives an external memory, such as a floppy disk or a  
5   laser card, containing the textual information. The textual  
information addresses a character generator in the form of a  
read-only memory within the electronic book. When  
addressed, the read-only memory supplies a font signal to  
permit excitation of selected pixels of a display device in  
10   the shape of a desired character. The external memory has a  
storage area allotted to store selected extra characters not  
contained in the read-only memory.

#### Brief Description of the Drawings

15       The invention is pointed out with particularity in the  
appended claims. However, other features of the invention  
will become more apparent and the invention will be best  
understood by referring to the following detailed  
20   description in conjunction with the accompanying drawings in  
which:

FIG. 1 is a view of an embodiment of an electronic book  
in a closed position;

25       FIG. 2 is a view of the embodiment of the electronic  
book of FIG. 1 in an open position;

FIG. 3 is a block diagram of an embodiment of the  
electronic book;

FIG. 4 is an illustration of various hot spot locations  
used to provide control of the electronic book to a user;

30       FIG. 5 is an illustration of a library screen display  
using an embodiment of the electronic book;

FIG. 6 is an illustration of a user-initiated event to  
open the desired book from the library screen;

35       FIG. 7 is an illustration of a first page of a book  
displayed on an embodiment of the electronic book;

- 0        FIG. 8 is an illustration of a title page of a book  
displayed on an embodiment of the electronic book;
- FIG. 9 is an illustration of a font selection page  
displayed on an embodiment of the electronic book;
- FIG. 10 is an illustration of the title page of the  
5    book which is displayed upon exiting the font selection  
page;
- FIG. 11 is an illustration of a system control page  
displayed in an embodiment of the electronic book;
- FIG. 12 is an illustration of the title page of the  
10   book which is displayed upon exiting the system control  
page;
- FIG. 13 is an illustration of the title page of the  
book wherein a radio frequency link option is selected;
- FIG. 14 is an illustration of the title page of the  
15   book wherein a pacing control option is selected by a user;
- FIG. 15 is an illustration of a pacing control page  
displayed in an embodiment of the electronic book;
- FIG. 16 is an illustration of the title page of the  
book which depicts other user-initiated options;
- 20        FIG. 17 is an illustration of a page marked by a dog  
ear for use in embodiments of the electronic book;
- FIG. 18 is an illustration of a dog ear dialog box used  
in embodiments of the electronic book;
- FIG. 19 is an illustration of a user selecting a  
25   portion of a page of text;
- FIG. 20 is an illustration of an option selection  
dialog box used in embodiments of the electronic book;
- FIG. 21 is an illustration of an annotation display  
used in embodiments of the electronic book;
- 30        FIG. 22 is an illustration of a marker used to indicate  
that a page has an annotation associated therewith;
- FIG. 23 is an illustration of a user selecting a set  
bookmark option in the option selection dialog box;
- FIG. 24 is an illustration of the page of FIG. 23  
35   having a bookmark displayed thereon;

0        FIG. 25 is a flow diagram of an event loop performed in an embodiment of the electronic book;

      FIG. 26 is a flow diagram of steps performed in an embodiment of a library graphical user interface routine for use in the electronic book;

5        FIGS. 27 and 28 show flow diagrams of an embodiment of the routine to display pages of text in the electronic book;

      FIG. 29 is a flow diagram of steps performed to display a current page in the electronic book;

10       FIG. 30 is a flow diagram of steps performed in an embodiment of an annotation subroutine;

      FIG. 31 is a flow diagram of steps performed in an embodiment of a quote capture subroutine;

      FIG. 32 is a flow diagram of steps performed in an embodiment of a dog ear subroutine;

15       FIG. 33 is a flow diagram of steps performed in an embodiment of a pacing control subroutine;

      FIG. 34 is a flow diagram of steps performed in an embodiment of the font selection subroutine;

20       FIG. 35 is a flow diagram of steps performed in an embodiment of the system control subroutine; and

      FIG. 36 is a block diagram of a system for encoding a book for reading using an electronic book having an internal machine-readable dictionary.

## 25       Detailed Description of a Preferred Embodiment

      Embodiments of the present invention advantageously provide an improved method and system for encoding a book for reading in an electronic book. The electronic book is  
30       equipped with an internal machine-readable dictionary containing a plurality of addressable words. Data representative of text of the book is encoded to form first machine-readable data representative of a customized dictionary to augment the internal machine-readable  
35       dictionary, and second machine-readable data representative



0 of a plurality of pointers which point to a corresponding  
plurality of words in the machine-readable dictionary and  
the customized dictionary. Data representative of graphical  
information is encoded to form third machine-readable data.  
The first, second, and third machine-readable data can be  
5 stored on a machine-readable storage medium for transfer to  
the electronic book. An access authorization level is  
provided on the machine-readable storage medium for  
authorizing access to at least one of the first machine-  
readable data, the second machine-readable data, and the  
10 third machine-readable data.

FIG. 1 is a view of an embodiment of an electronic book  
in a closed position. The electronic book has a book-shaped  
housing 100 having the look and feel of a real, paper book.  
The book-shaped housing 100 has a first housing member 102  
15 pivotably connected to a second housing member 104 to  
facilitate opening and closing in a book-like manner. The  
first housing member is partially formed by a book-like,  
front cover member 106. In a similar manner, the second  
housing member 104 is partially formed by a book-like, back  
20 cover member 108. The front cover member 106 and the back  
cover member 108 are pivotably connected by a spine member  
110.

To better provide the look and feel of a real book, the  
front cover member 106 and the back cover member 108 have an  
25 exterior made of a material used in real book covers.  
Examples of such a material include, but are not limited to,  
leather, simulated leather, vinyl, and a woven fabric such  
as cotton. The exterior can either be permanently affixed  
to the front cover member 106 and the back cover member 108,  
30 or be in the form of a removable jacket.

In addition to the front cover member 106, the first  
housing member 102 is partially defined by an enclosure 112.  
Similarly, the second housing member 104 is partially  
defined by an enclosure 114 in addition to the back cover  
35 member 108. When the electronic book is in the closed

0 position, the enclosure 112 and the enclosure 114 have an  
external appearance of edges of pages of a real, paper book.  
In particular, the enclosures 112 and 114 define a top edge  
116, a bottom edge 118, and a foreedge 120 which appear as  
the top edge, the bottom edge, and the foreedge,  
5 respectively, of a real, paper book. The top edge 116, the  
bottom edge 118, and the foreedge 120 are recessed with  
respect to the front cover member 106 and the back cover  
member 108.

FIG. 2 is a view of the embodiment of the electronic  
10 book of FIG. 1 in an open position. It is preferred that  
the first housing member 102 and the second housing member  
104 be substantially symmetric so that the front cover  
member 106, the back cover member 108, and the spine member  
110 rest substantially flat on a flat surface in the open  
15 position. The substantial symmetry makes the electronic  
book feel like a real, paper book being opened to one of its  
middle pages. As a result, the electronic book can be  
comfortably held and read in a manner consistent with a  
paper book.

20 A touchscreen 130 is integrated in the book-shaped  
housing 100 to be accessible when the book-shaped housing  
100 is opened in the book-like manner. In the embodiment  
illustrated in FIG. 2, the touchscreen 130 is integrated  
with the enclosure 114 of the second housing member 104.  
25 Optionally, a second touchscreen 132 can also be integrated  
in the book-shaped housing. As illustrated, the second  
touchscreen 132 can be integrated with the enclosure 112 of  
the first housing member 102.

The touchscreen 130 and the second touchscreen 132 each  
30 include a touch-sensitive panel over a display device.  
Behind the display device can be a backlighting element.

The touchscreen 130 and the second touchscreen 132 may  
provide either a color display or a monochrome display  
depending on a particular model of the electronic book. To  
35 provide their touch sensitivity, the touchscreen 130 and the

0 second touchscreen 132 can utilize analog resistive  
technology as is known in the art. It is noted, however,  
that other technologies for providing touch sensitivity can  
also be utilized.

It is preferred that the touchscreen 130 and the second  
5 touchscreen 132 be capable of providing backlighting to  
allow use of the electronic book in poorly-lit or dimly-lit  
environments. More preferably, the touchscreen 130 is  
capable of backlighting selected portions or subsets of the  
entire touchscreen 130. Here, the electronic book can  
10 provide a power-saving mode wherein only a portion of the  
touchscreen 130 being viewed by a user is actively backlit.

The book-shaped housing includes a receiving slot 134  
which physically receives a removable machine-readable  
storage medium 136. The removable machine-readable storage  
15 medium 136 contains machine-readable data representative of  
text from a book. Optionally, the machine-readable data is  
also representative of graphical information within the  
book. It is noted that the term "book" should be construed  
broadly as any written or printed composition having textual  
20 information which is read by an individual. Hence, the term  
"book" should be inclusive of books, magazines, newspapers,  
or the like.

The text and the graphical information contained in the  
removable machine-readable storage medium 136 are displayed  
25 on the touchscreen 130. The second touchscreen 132 can be  
included to display graphical information while the  
touchscreen 130 displays text. As another option, the  
touchscreen 130 and the second touchscreen 132 can display  
neighboring pages of the book. Further, the touchscreen 130  
30 and the second touchscreen 132 can be utilized to  
simultaneously view two books. The second touchscreen 132  
can also be utilized in a second level operating system,  
which is herein called an advanced reader graphical user  
interface. The functionality of the second touchscreen 132  
35 can be selected by the user using a switch or the advanced

0 reader graphical user interface in the electronic book.

It is noted that there are a number of ways to encode the text and the graphical information within the book for storage on the removable machine-readable storage medium 136. In one embodiment, the removable machine-readable storage medium 136 contains a series of pointers which point to words contained in a dictionary within the electronic book. Words which are not contained in the dictionary are located in a customized dictionary on the removable machine-readable storage medium 136. In this way, the words to be presented on the touchscreen 130 are selected with minimal storage requirements in the removable machine-readable storage medium 136.

Preferably, the removable machine-readable storage medium 136 is in the form of either a smart card or a PCMCIA card. Here, the receiving slot 134 is shaped to receive either a smart card or a PCMCIA card.

The book-shaped housing 100 further defines a power-receiving port 138 and a data-receiving port 140. The power-receiving port 138 receives a plug or other type of connector to supply power to the electronic book. Power supplied to the electronic book via the power receiving port 138 can be used to directly operate the electronic book or to recharge batteries internal to the electronic book. In one embodiment of the electronic book, the spine member 110 is shaped to receive a combination of battery cells which can be recharged via the power-receiving port 138. If the second touchscreen 132 is not used, the enclosure 112 of the first housing member 102 can be used to store extra batteries and/or extra book cards.

The data port 140 is utilized to communicate signals representative of machine-readable data between the electronic book and an external device. The data port 140 can be used, for example, to receive machine-readable data signals representative of text and graphics in a book from the external device for storage in the electronic book. In

0 this manner, the data port 140 provides an alternative to  
the receiving slot 134 for receiving text and graphics of a  
book. Additionally, the data port 140 can be utilized to  
transmit machine-readable data contained within the  
electronic book to the external device.

5 Preferably, the electronic book is automatically  
activated (i.e., automatically turns on) when in the open  
position, and is automatically deactivated (i.e.  
automatically turns off) when in the closed position. To  
this end, the electronic book can include a magnet 142  
10 incorporated within one of the first housing member 102 or  
the second housing member, and a reed switch 144  
incorporated within the other housing member. When the  
electronic book is in the closed position, the magnet 142 is  
proximate to the reed switch 144. The magnetic field  
15 generated by the magnet 142 causes the reed switch 144 to  
assume a first switch position which deactivates the  
electronic book. When the electronic book is in the open  
position, the magnet 142 is distant from the reed switch  
144. In absence of a significant magnetic field, the reed  
20 switch 144 returns to a second switch position which  
activates the electronic book.

It is noted that in alternative embodiments, the  
electronic book is activated and deactivated by an external  
switch or button (not specifically illustrated) rather than  
25 by the reed switch 144.

FIG. 3 is a block diagram of an embodiment of the  
electronic book. An interface 150 receives the removable  
machine-readable storage medium 136 containing machine-  
readable data representative of text and graphics from a  
30 book. In a preferred embodiment of the present invention,  
the interface 150 comprises a PCMCIA interface which  
receives a removable machine-readable storage medium in the  
form of a PCMCIA card. Physically, the interface 150 is  
proximate to the receiving slot 134 illustrated in FIG. 2.

35 In general, it is preferred that the interface 150 be

0 capable of receiving an external device other than a  
machine-readable storage medium. Further, it is preferred  
that the interface 150 be capable of receiving a plurality  
of external devices. To these ends, the interface 150 can  
comprise a plurality of similar interfaces, such as a  
5 plurality of PCMCIA interfaces. Here, the electronic book  
can simultaneously receive two or more of a PCMCIA memory  
card, a PCMCIA modem, or another PCMCIA device.

A processor 152 is in communication with the interface  
150 to read the machine-readable data from the removable  
10 machine-readable storage medium 136. The processor 152 can  
be in the form of a microprocessor, a custom integrated  
circuit, an application specific integrated circuit, or a  
programmable logic array, for example. Physically, the  
processor 152 is housed within the book-shaped housing 100.

15 The touchscreen 130 is in communication with the  
processor 152 to display a page of the text and/or the  
graphics represented by the machine-readable data. Further,  
the touchscreen 130 acts as an input device to receive user-  
initiated events, i.e. user-initiated actions, and  
20 communicate these user-initiated events or actions to the  
processor 152.

An internal machine-readable storage medium 154 is in  
communication with the processor 152 to support a number of  
operative features of the electronic book. The internal  
25 machine-readable storage medium 154 can include one or more  
memory devices, such as a random access memory, a read-only  
memory, and/or an electronically erasable and programmable  
read-only memory (EEPROM).

A computer program or other form of software or  
30 firmware is stored in the internal machine-readable storage  
medium 154. The computer program directs the processor 152  
to support the operative features of the electronic book.  
Preferably, the computer program includes an event loop that  
processes and responds to user-initiated events and actions.  
35 More specifically, received events are placed in an event

0 queue in the internal machine-readable storage medium 154. Each of the received events is processed and removed from the event queue. As a result, a user can initiate a number of events or actions without having to wait for previous actions to be processed.

5 The internal machine-readable storage medium 154 can also include a dictionary to which pointers stored in the removable machine-readable storage medium 136 point. By including the dictionary within the electronic book, less storage space is required on the removable machine-readable storage medium 136 to store the text from the book.

10 Further, the internal machine-readable storage medium 154 can contain machine-readable data representative of text and graphics from a book. Here, the processor 152 reads the machine-readable data from the internal machine-readable storage medium 154 and commands the touchscreen 130 to display pages of the text and graphics.

15 Signals are communicated between the electronic book and an external device via either a data interface 156 in communication with the processor 152, via an antenna 158 and a radio frequency modem 160 in communication with the processor 152, or via an infrared transceiver 161 in communication with the processor. As another option, communication between the electronic book and the external device can be effectuated using either a smart communication card or a PCMCIA communication card received by the interface 150. Here, a PCMCIA modem card or a PCMCIA infrared transceiver card can be utilized, for example, for external communication.

20 Optionally, a voice synthesizer 162 is included in the electronic book to provide a spoken auditory display of pages of the text read from either the removable machine-readable storage medium 136 or the internal machine-readable storage medium 154. In one embodiment, the processor 152 directly converts the text from the book into speech signals for the voice synthesizer 162. Optionally, control codes

35

0 can be provided within the removable machine-readable  
storage medium 136 to allow words to be pronounced or  
emphasized in different ways. Further, the control codes  
can command the words to be spoken in either a male voice, a  
female voice, or a child's voice. The synthesized voice can  
5 be sampled (such as using the user's voice) or can be a  
computer-synthesized voice.

As an alternative, a custom voice dictionary can be  
provided to augment a general voice dictionary stored in the  
electronic book. The customized voice dictionary can be  
10 used for alternative pronunciations, voices, and emphasis.

The voice synthesizer 162 is either permanently  
integrated in the electronic book or is a removable  
accessory. To facilitate removability, the voice  
synthesizer 162 can be embodied within a smart card or a  
15 PCMCIA card for reception by the interface 150.  
Alternatively, the voice synthesizer 162 can communicate  
with the processor 152 via an accessory interface bus 163.  
In a similar manner, the RF modem 160 and/or the second  
touchscreen 132 can communicate with the processor 152 via  
20 the accessory interface bus 163.

Before giving a detailed description of steps performed  
by the elements of FIG. 3 for the various embodiments of the  
present invention, a functional description of a particular  
embodiment of the electronic book will now be described.  
25 This embodiment is based on a single touchscreen, namely the  
touchscreen 130, to display the text and the graphics of the  
book and to allow a user to control the electronic book. It  
is noted, however, that the teachings herein can also be  
applied to a dual touchscreen embodiment which further  
30 includes the second touchscreen 132. Furthermore, it is  
noted that the teachings herein are not limited to the use  
of a touchscreen, and hence, can be applied to an electronic  
book containing any type of display device (such as a liquid  
crystal display or a cathode ray tube, for example) and any  
35 type of input device (such as a series of buttons, a mouse,



0 a trackball, a lightpen, or a touchpad, for example).

FIG. 4 is an illustration of various hot spot locations used to provide control of the electronic book to a user. A page of the text represented by the machine-readable data read from either the removable machine-readable storage  
5 medium 136 or the internal machine-readable storage medium 154 is displayed on a display portion 168 of the touchscreen 130. The display portion 168 is also utilized to display graphics represented by the machine-readable data.

A first hot spot portion 170 of the touchscreen 130 is  
10 designated for receiving a predetermined user-initiated event which requests that a subsequent page of the text be displayed on the touchscreen 130. Hence, the first hot spot portion 170 can be synonymously referred to as an "advance page portion" or an "advance page hot spot" for receiving an  
15 advance page event. In the embodiment illustrated in FIG. 4, the first hot spot portion 170 includes a top margin portion 172, a side margin portion 174, and a bottom margin portion 176 of the touchscreen 130. The top margin portion 172 is located above the display portion 168, the side  
20 margin portion 174 is located beside the display portion 168, and the bottom margin portion 176 is located below the display portion 168.

A second hot spot portion 178 of the touchscreen 130 is designated for receiving a predetermined user-initiated  
25 event which requests that a previous page of the text be displayed. Hence, the second hot spot portion 178 can be synonymously referred to as a "page back portion" or a "page back hot spot" for receiving a page back event. In the embodiment illustrated in FIG. 4, the second hot spot  
30 portion 178 is located beside the display portion 168 of the touchscreen 130 and opposite the side margin portion 174.

A third hot spot portion 180 of the touchscreen 130 is designated for receiving a predetermined user-initiated event which requests that a pre-marked page be displayed on  
35 the touchscreen 130. In the embodiment of FIG. 4, the third

0 hot spot portion 180 is located in an upper portion of the  
touchscreen 130 and is shaped as a bookmark graphic 182.  
Hence, the third hot spot portion 180 can be synonymously  
referred to as a "bookmark portion" or a "bookmark hot  
spot".

5 A fourth hot spot portion 184 of the touchscreen 130 is  
designated for receiving a predetermined user-initiated  
event to close the current book being read and to request  
that a library screen be displayed on the touchscreen 130.  
The library screen is utilized by a user to select a book to  
10 read from a plurality of books within a library. Hence, the  
fourth hot spot portion 184 can be synonymously referred to  
as a "close book portion" or a "close book hot spot" for  
receiving a close book event.

A fifth hot spot portion 186 of the touchscreen 130 is  
15 designated for receiving a predetermined user-initiated  
event which requests that the displayed page be marked. In  
the embodiment of FIG. 4, the fifth hot spot portion 186 is  
located in an upper corner of the touchscreen 130. In this  
embodiment, the fifth hot spot portion 186 of the  
20 touchscreen 130 is utilized for dog-earring pages of the  
book. Hence, the fifth hot spot portion 186 can be  
synonymously referred to as a "dog ear portion" or a "dog  
ear hot spot" for receiving a dog ear event.

A sixth portion 188 of the touchscreen 130 is  
25 designated to provide a depth indication representative of  
how much of the book is left to be read. In the embodiment  
illustrated in FIG. 4, the sixth portion 188 is located  
above the display portion 168. The second hot spot portion  
178 can be utilized in conjunction with the sixth portion  
30 188 to provide the depth indication.

In the embodiment of FIG. 4, the display portion 168,  
the first hot spot portion 170, the second hot spot portion  
178, the third hot spot portion 180, the fourth hot spot  
portion 184, and the fifth hot spot portion 186 are mutually  
35 exclusive (i.e. non-overlapping) portions of the touchscreen

0 130. However, in alternative embodiments of the present invention, these portions may not be mutually exclusive, and hence may overlap. Further, some embodiments of the present invention may utilize different sizes and positions for the above-described hot spot portions.

5 Preferably, the hot spot portions are motion sensitive so that a touch event, a touch-and-hold event, and a drag event can be sensed to initiate differing responses. For example, a page back event can be received in the form of a flipping motion (i.e. a short stroke) across the second hot  
10 spot portion 178.

FIG. 5 is an illustration of a library screen displayed using an embodiment of the electronic book. In a preferred embodiment, the library screen is displayed upon opening the electronic book or activating the electronic book. The  
15 library screen includes a rearward graphical book representation 200 having a graphical spine portion 202. A forward graphical book representation 204 is displayed in front of the rearward graphical book representation 200. The forward graphical book representation 204 has a  
20 graphical spine portion 206 and a graphical front cover portion 208. A title 210 of a book currently being read is displayed on the forward graphical book representation 204. In the embodiment illustrated in FIG. 5, the title 210 is displayed on the graphical spine portion 206 of the forward  
25 graphical book representation 204.

Upon receiving a user-initiated event in which a portion of the rearward graphical book representation 200 is selected, a title of another book or books of a plurality of books in a library is displayed in place of the title 210 on  
30 the forward graphical book representation 204. In a preferred embodiment, the portion of the rearward graphical book representation 200 selected in this user-initiated event is within the graphical spine portion 202.

The titles of the books in the library can be obtained  
35 from a storage medium (which contains the books) installed

0 in the electronic book. Alternatively, the titles of the books can be obtained by a connection to an information service providing books or other information in real time. As another alternative, the titles and the books can be accessed on demand from a world-wide web page.

5 A user can scroll through the library of books by repeatedly touching the spine portion 202 with his or her finger 212 until a desired book title is pulled into view. When the spine portion 202 is selected for a last of the plurality of books, the title of the first book is  
10 displayed. In this manner, the user can rotate through the library of books until a desired book is in front.

FIG. 6 is an illustration of a user-initiated event to open the desired book from the library screen. The forward book is opened upon receiving a user-initiated event in  
15 which a portion of the forward graphical book representation 204 is selected. This user-initiated event can include, for example, the user touching the front cover portion 208 of the forward graphical book representation 204 using his or her finger 212. In response to this user-initiated event,  
20 the book indicated by a title 214 is opened. If the book is previously unread, the book is opened to page one. If the book has been read before, the book opens to a page which was last read.

FIG. 7 is an illustration of a first page of a book  
25 displayed on the touchscreen 130 upon exiting the library screen. To display the first page of the book, the machine-readable data representative of text and graphics from the book is read from either the removable machine-readable storage medium 136 installed in the electronic book, or from  
30 the internal machine-readable storage medium 154. Upon reading the machine-readable data, a page of the text and/or the graphics is then displayed on the touchscreen 130. As shown, the text is displayed to appear as a standard page in a real book.

35 If a user-initiated event is received in which a user

0 selects the second hot spot portion 178, i.e. the page back portion, of the touchscreen 130 when the book is on the first page, then a title page containing system controls is displayed.

FIG. 8 is an illustration of a title page of a book  
5 displayed on an embodiment of the electronic book. Information which is displayed on the title page includes a book title 220, author information 222, copyright information 224, a Library of Congress number 226, and publisher information 228. Also displayed are statistics  
10 such as a total number of pages 230 in the book, a number of pages left to be read 232, and an elapsed reading time 234.

A number of control options are also displayed. These control options include, but are not limited to, a pacing control option 236, a font selection option 238, a system  
15 control option 240, a read-to-me option 242, and a radio frequency (RF) link option 244. Any of these control options can be initiated by a respective user-initiated event indicative of a user selecting the option. As illustrated in FIG. 8, a user is initiating a font selection  
20 routine by touching the font selection option 238 using his or her finger 212.

FIG. 9 is an illustration of a font selection page displayed on an embodiment of the electronic book. The font selection page is displayed upon an initiation of the font  
25 selection routine.

Displayed on the font selection page are a number of font/size combination options. Each option is in the form of a word displayed using a specific font and a specific size in accordance with the font/size combination. A user  
30 selects a desired font/size combination by viewing how words appear in the various combinations, and selecting the combination which is desired. For example, in FIG. 9, the user is selecting a desired font/size combination by selecting a word 250 displayed in the desired font/size  
35 combination using his or her finger 212.

0       The fonts can be selected from internal fonts and  
custom fonts provided on the medium provided by a publisher.  
For example, a user may select a Gothic font provided on a  
medium containing a Shakespeare work instead of default  
fonts (e.g. Courier, Helvetica, Avant Garde) within the  
5       electronic book.

      Upon selecting the desired font/size combination, the  
electronic book automatically flips back to the title page  
containing the system controls. Thereafter, the electronic  
book uses the desired font/size combination as a primary  
10      font/size combination to display the text of the book.  
Titles and headings in the book are enlarged and bolded  
based upon the primary font/size combination. Other  
portions of text can be italicized based on the primary  
font. However, it is preferred that the body of the text  
15      never be displayed smaller than the size selected in the  
primary font/size combination. In some embodiments, it may  
be preferred to display footnotes in a size smaller than the  
size selected.

      FIG. 10 is an illustration of the title page of the  
20      book which is displayed upon exiting the font selection  
page. Here, a user is shown to initiate a system control  
routine by selecting the system controls option 240 using  
his or her finger 212.

      FIG. 11 is an illustration of a system control page  
25      displayed in an embodiment of the electronic book. The  
system control page is displayed upon executing the system  
control routine.

      The system control page provides a number of display  
controls including a contrast control 254, a tint control  
30      256, and a color control 258. Each of these controls  
provides a discrete number of control values which can be  
directly selected by a user. Further, each control value is  
displayed in a graphical manner consistent with the result  
of its selection. For example, the contrast control 254  
35      includes a high contrast graphical representation 262, an

0 intermediate contrast graphical representation 264, and a  
low contrast graphical representation 266. The graphical  
representations 262, 264, and 266 are of the same graphical  
image, but are displayed using different contrast control  
values. Hence, a user can visually determine a desired  
5 contrast by viewing the graphical representations 262, 264  
and 266. In a similar manner, the tint control 256 and the  
color control 258 each display a predetermined graphical  
image using a discrete number of tint control values and  
color control values, respectively.

10 Preferably, the display of the graphical  
representations within the display controls are unaffected  
by current values of selected ones of the controls. In one  
preferred embodiment, the display of the graphical  
representations is independent of all of the current values.  
15 For example, the display of the low contrast representation  
266 can be independent of the current contrast control  
value, the current tint control value, and the current color  
control value. In another preferred embodiment, the display  
of the graphical representations in each control is  
20 independent of the current value of that control, but depend  
on the current value of the other controls. Here, for  
example, the display of the low contrast representation 266  
is independent of the current contrast control value, but  
dependent upon the current tint control value and the  
25 current color control value. Using either of these two  
embodiments, a user can immediately determine a result of  
each control value selection before actually performing the  
selection.

30 The system control page also includes a sound control  
267. The sound control 267 is illustrated to have a  
discrete number of sound intensity values which can be  
selected by a user. In the embodiment of FIG. 11, the sound  
intensity values are monotonically related to the size of an  
ear displayed on the sound control 267. An ear 268 having a  
35 slash therethrough is indicative of an option to turn off

0 the sound. For the purpose of illustration, FIG. 11 shows a user selecting an intermediate sound intensity by touching an ear graphic 269. The user then returns to the system control page by touching the second hot spot portion 178, i.e. the page back hot spot, of the touchscreen 130.

5 It is noted that the controls on the system control page can provide continuous, rather than discrete, control of the control values in alternative embodiments of the electronic book. Here, for example, the ear size and the volume can increase or decrease based on finger selection movement.

10 A pad area 270 of the system control page is utilized for testing motions such as a hold event, a turn event, and a mark event. In particular, a user can point to any of a hold selection 271, a turn selection 272, and a mark selection 273, and then perform the selected motion in the pad area 270. Here, a length of hold time or style of dragging a finger for a flip command can be gauged for each user, for example, using the pad area 270.

15 FIG. 12 is an illustration of the title page of the book which is displayed upon exiting the system control page. Here, the user is illustrated to select the read-to-me option 244 which initiates the voice synthesizer 162 to audibly read the text being visually displayed on the touchscreen 130. The audible reading of the text begins at the last page which was displayed on the touchscreen 130. The reading rate and other controls for the read-to-me routine is provided on a pacing control page described hereinafter.

20 FIG. 13 is an illustration of the title page of the book wherein a radio frequency link option is selected. This option is selected by the user by touching the RF link option 244 using his or her finger 212. Upon selecting the RF link option 244, an RF link routine is executed. The RF link routine allows the user to download updates of the text to the electronic book, and/or to interface the electronic

25 30 35



0 book to a personal computer or communication unit. The RF link routine utilizes the antenna 158 and the RF modem 160 illustrated in FIG. 3 to communicate with the personal computer using a local wireless link, or more generally to communicate with a wireless data communication network.

5 Utilizing a nationwide wireless data communication network, such as the Ardis network, allows individuals to receive book updates via radio frequency links in major cities.

FIG. 14 is an illustration of the title page of the book wherein a pacing control option is selected by a user. Specifically, the user is shown to initiate a pacing control routine by selecting the pacing control option 236 displayed on the title page using his or her finger 212.

FIG. 15 is an illustration of a pacing control page displayed in an embodiment of the electronic book. The pacing control page is displayed once the user selects the pacing control option 236 from the title page. The pacing control page includes a display 280 of a current reading pace of the user. Based upon the number of pages left in the book, which is given in a display 282, a display 284 of an estimated completion time for the book is also given. In the embodiment of FIG. 15, the current reading pace, the number of pages left, and the estimated completion time are displayed in the form of one or more sentences.

Also displayed on the pacing control page is a display 290 of a desired reading pace. A display 292 of an estimated completion time in accordance with the desired reading pace is also given. The desired reading pace is controlled by the user using a graphical slider bar 294. The pages of the text in the book are automatically paced by a pacing routine which is enabled and disabled by a graphical switch 296. In one embodiment, each page of text is displayed for a duration commensurate with the desired reading rate controlled by the graphical slider bar 294. The user returns to the title page from the pacing control page by selecting the second hot spot portion 178, i.e. the

0 page back portion, of the touchscreen 130.

FIG. 16 is an illustration of the title page of the book which depicts other user-initiated options. The user can return to a book-marked page by selecting the bookmark graphic 182. The user can return to the library screen by  
5 selecting the fourth hot spot portion 184, i.e. the close book portion, of the touchscreen 130. The user can go to the first page of the book by selecting the first hot spot portion 170, i.e. the advance page portion, of the touchscreen 130.

10 FIG. 17 is an illustration of a page marked by a dog ear in an embodiment of the electronic book. The user initiates a dog ear command by performing a predetermined user-initiated event. An example of such an event includes a user touching an upper corner portion of the touchscreen  
15 130, such as the fifth hot spot portion 186 defined earlier.

If the page is not dog-eared, then a brief touching of the upper corner portion 186 causes a dog ear graphic 300 to be displayed in the upper corner portion. In addition, an indication that this page has been dog-eared is stored  
20 either in the removable machine-readable storage medium 136 or the internal machine-readable storage medium 154.

If the user touches the upper corner portion 186 of a page already marked with a dog ear, or if the upper corner portion 186 is held for a duration greater than a  
25 predetermined threshold, then a dog ear dialog box is opened.

FIG. 18 is an illustration of a dog ear dialog box used in embodiments of the electronic book. A dog ear dialog box 302 is displayed on touchscreen 130. The dog ear dialog box  
30 302 displays a list 304 of all dog-eared pages. A user can immediately go to one of the dog-eared pages on the list 304 by touching a display of a selected page number.

The dog ear dialog box 302 also displays an option 306 to display marks 308 along an edge 310 of the page.  
35 Thereafter, a user can touch any of the marks 308 to move

0 quickly to a corresponding one of the dog-eared pages. In  
the example illustrated in FIG. 18, a mark 312 corresponds  
to marked page 1, a dog ear 314 corresponds to marked page  
35, a mark 316 corresponds to marked page 94, a mark 318  
corresponds to marked page 111, and a mark 320 corresponds  
5 to marked page 120. In a preferred embodiment, page one is  
always marked with a dog ear so that a user can quickly  
return thereto using either the marks 308 or the dog ear  
dialog box 302.

Upon receiving a user-initiated event while the dog ear  
10 dialog box 302 is displayed, the dog ear dialog box 302 is  
removed to show the selected page of the book.

FIG. 19 is an illustration of a user selecting a  
portion of a page of text. A portion 330 is selected by a  
user-initiated event of sliding his finger 212 (or other  
15 pointing member such as a stylus) from a first position 332  
to a second position 334. Upon its selection, the portion  
330 of the text is highlighted in a predetermined manner.  
The portion 330 of the text can be highlighted in color if  
the touchscreen 130 is capable of a color display.  
20 Alternatively, the portion 330 of the text can be  
highlighted using grey scale shading, reverse video, or  
underlining. An option selection dialog box is then  
displayed on the touchscreen 130 to provide the user a  
number of text marking options.

25 FIG. 20 is an illustration of an option selection  
dialog box used in embodiments of the electronic book. An  
option selection dialog box 340 is displayed on the  
touchscreen 130 in a location out of the way of the portion  
330 of the text that is marked when possible. The option  
30 selection dialog box 340 includes a plurality of text  
marking options including a note capture option 342, a  
highlighting option 344, a quote capture option 346, and a  
set bookmark option 348.

Briefly, the note capture option 342 allows a user to  
35 type in notes associated with the portion 330 of the text.

0 The highlighting option 344 leaves the portion 330 of the  
text highlighted, and stores an indication of this  
highlighting so that any subsequent return to this page  
displays the portion 330 as being highlighted. The quote  
capture option 346 allows a user to store the portion 330 of  
5 the text along with source data, such as the name of the  
author of the book or the title of the book, in the internal  
machine-readable storage medium 154. The set bookmark  
option 348 can be selected to add a bookmark to the current  
page. If the page already has a bookmark, then a number of  
10 bookmark management options similar to options used for the  
dog ear command are provided to the user.

FIG. 21 is an illustration of an annotation display  
used in embodiments of the electronic book. The annotation  
display is provided in response to a user selecting the note  
capture option 342 illustrated in FIG. 20. After receiving  
15 a user-initiated event indicative of selecting the note  
capture option 342, a soft keyboard 360 is displayed on the  
touchscreen 130. The soft keyboard 360 includes  
alphanumeric keys and symbolic keys along with a close key  
20 and a notes collection key.

A plurality of keystroke events are received by the  
soft keyboard 360 to form an annotation. As the keystroke  
events are received, a plurality of characters corresponding  
thereto are displayed in a window 362 on the touchscreen  
25 130.

The user selects the close key on the soft keyboard 360  
upon completing the annotation. In response to selecting  
the close key, the electronic book removes the soft keyboard  
360 and the window 362 from the touchscreen 130 and displays  
30 a note marker icon to indicate that the page has an  
annotation associated therewith.

The notes collection key on the soft keyboard 360  
commands the electronic book to communicate the annotation  
to an external device such as a personal computer. The  
35 personal computer can be interfaced to the electronic book

0 either wirelessly via the antenna 158 and the radio  
frequency modem 160 shown in FIG. 3, using a wire-based  
connection via the data interface 156, or using an infrared  
link.

5 An annotation can also be in the form of an image of  
pixels which overlays the page of the text. The pixels can  
be drawn on the touchscreen 130 using a pointing device.  
The pixels can be stored in a pixel-map form for subsequent  
viewing or for subsequent conversion to text using a  
handwriting recognition method.

10 As another option, an accessory keyboard can be added  
to the electronic book to enter the annotation as well as  
other information.

FIG. 22 is an illustration of a marker used to indicate  
that a page has an annotation associated therewith. The  
15 page illustrated in FIG. 22 results after the user enters  
the annotation and selects the close key from the soft  
keyboard 360 as illustrated in FIG. 21. As shown, the page  
in FIG. 22 no longer has the soft keyboard 360 and the  
window 362 displayed thereon. However, a note marker icon  
20 370 is displayed in a lower corner of the page. The user  
can view the annotation associated with this page by  
selecting the note marker icon 370. Selecting the note  
marker icon 370 has the same effect as selecting the note  
capture option 342 as shown in FIG. 20.

25 Further, an annotation can be indicated by underlining  
or highlighting the portion of the text associated with the  
annotation. The annotation can be viewed in a hypertext-  
type manner by selecting the portion of text.

FIG. 23 is an illustration of a user selecting a set  
30 bookmark option in the option selection dialog box. The  
user selects the set bookmark option 348 by touching the  
displayed text associated therewith using his or her finger  
212 or other pointing member. If this page had already  
included a bookmark, then a bookmark management dialog box  
35 is displayed similar to the one used for the dog ear

0 command. Since the page illustrated in FIG. 23 does not have a bookmark associated therewith, the selection of the set bookmark option 348 causes a bookmark to be added to the page. In a preferred embodiment, only one page is bookmarked within each book.

5 FIG. 24 is an illustration of the page of FIG. 23 having a bookmark displayed thereon. A bookmark icon 380 is displayed in an upper portion of the page to indicate that the page has been bookmarked.

It is noted that pointing devices other than an individual's finger may be utilized to generate user-initiated events indicative of desired selections using the touchscreen 130. For example, a stylus or the like can be utilized to select desired portions of the touchscreen 130.

15 It is also noted that various types of graphical controls can be utilized to control settings and parameters of the electronic book. These graphical controls include, but are not limited to, graphical buttons, checkboxes, radio buttons, scroll bars, slider bars, pop-up menus, and dialog boxes.

20 Next, a description of steps which are performed by the various components of the electronic book to provide its features and functionality is presented. These operational steps are performed on or with the aid of the processor 152 illustrated in FIG. 3. The processor 152 is directed to function in a manner in accordance with these operational steps based upon a computer program or other form of software or firmware stored in a computer readable memory. The computer readable memory can be contained with the processor 152, within the internal machine-readable memory 25 154, or within a separate machine-readable storage medium in communication with the processor 152.

35 It is noted that the order in which the steps are described are indicative of one embodiment of the present invention, and that alternative embodiments of the present invention may perform the steps in a different order to

0 achieve the same functionality.

FIG. 25 is a flow diagram of an event loop performed in an embodiment of the electronic book. As indicated by block 400, a step of executing a library graphical user interface routine is performed. The library graphical user interface  
5 routine provides a virtual library to allow a user to select a book to read from a plurality of books within a library, and/or access an information service or world-wide web page as previously described. The plurality of books can be contained in one or more removable machine-readable storage  
10 media and/or the internal machine-readable storage medium.

Upon selecting a desired book, a step of executing a routine to display one or more pages of text and graphics from the desired book is performed as indicated by block 402. The routine to display the pages of text is executed  
15 until a predetermined user-initiated event is received to exit the routine. As indicated by block 404, if a close book event is received, then flow of the event loop is directed back to the step of executing the library graphical user interface routine in block 400.

20 If a page back event is received when the current page of text being read is page one, then a step of displaying a title page of the book is performed as indicated by block 406. The title page provides a number of control options available to a user. The user selects a desired control  
25 option based upon a user-initiated event. Block 408 indicates a step of receiving this user-initiated event.

Based upon the user-initiated event which is received, flow of the event loop is directed to one of a number of subroutines in a step indicated by block 410. If the  
30 received event is indicative of the user selecting the pacing control option, then a step of executing a pacing control routine is performed as indicated by block 412. If the received event is indicative of the user selecting the font selection option, then a step of executing a font  
35 selection routine is performed as indicated by block 414.

0 If the received event is indicative of the user selecting  
the system control option, then a step of executing a system  
control subroutine is performed as indicated by block 416.  
If the received event is indicative of the user selecting  
the RF link option, then a step of executing an RF link  
5 subroutine is performed as indicated by block 420. Upon  
completing either the pacing control subroutine, the font  
selection routine, the system control routine, or the RF  
link routine, flow of the event loop is directed back up to  
block 406 wherein the step of displaying the title page is  
10 performed.

If the received event from block 408 is indicative of  
the user selecting the read-to-me option, then a step of  
executing a read-to-me routine is performed as indicated by  
block 422. Flow of the event loop is then directed back to  
15 block 402 to execute the routine to display pages of text  
from the book. The execution of the read-to-me routine in  
block 422 provides a spoken, auditory display of the text in  
addition to the visual display of the text in block 402.

If the event received in the step of block 408 is an  
20 advance page event, then a step of setting the current page  
to page one is performed as indicated by block 424. If the  
received event is indicative of the user selecting a  
bookmark displayed on the title page, then a step of setting  
the current page to a previously bookmarked page is  
25 performed as indicated by block 426. After the current page  
is set in either of the steps indicated by blocks 424 and  
426, then flow of the event loop is directed back to the  
step of executing the routine to display pages of text  
indicated by block 402.

30 Finally, if the event received in block 408 is  
indicative of a close book event, then flow of the event  
loop is directed back to block 400 to perform a step of  
executing the library graphical user interface routine.

FIG. 26 is a flow diagram of steps performed in an  
35 embodiment of a library graphical user interface routine for



31

0 use in the electronic book. These steps can be performed in  
executing the library graphical user interface routine  
indicated by block 400 in FIG. 25. The steps provide a  
method of selecting a book for reading in an electronic book  
where the book is selected from a plurality of books in a  
5 library.

As indicated by block 430, a step of displaying a  
rearward graphical book representation having a graphical  
spine portion is performed. A step of displaying a forward  
graphical book representation in front of the rearward  
10 graphical book representation is performed as indicated by  
block 432. The forward graphical book representation has a  
graphical spine portion and a graphical front cover portion.

As indicated by block 434, a step of displaying a title  
of a first book of the plurality of books on the forward  
15 graphical book representation is performed. The title of  
the first book can be displayed anywhere on the forward  
graphical book representation. However, in a preferred  
embodiment, the title of the first book is displayed on the  
graphical spine portion of the forward graphical book  
20 representation. FIG. 5 illustrates an example of the  
rearward graphical book representation 200 having the  
graphical spine portion 202, the forward graphical book  
representation 204 having the graphical spine portion 206  
and the graphical front cover portion 208, and the title 210  
25 displayed on the forward graphical book representation 204.

With reference again to FIG. 26, a step of receiving a  
first user-initiated event in which a portion of the  
rearward graphical book representation is selected is  
performed as indicated by block 436. In a preferred  
30 embodiment, the portion of the rearward graphical book  
representation selected in this step is within the graphical  
spine portion of the rearward graphical book representation.  
Upon receiving the first user-initiated event, a step of  
displaying a title of a second book of the plurality of  
35 books is performed as indicated by block 440. Preferably,

0 the title of the second book is displayed in place of the  
title of the first book on the graphical spine portion of  
the forward graphical book representation.

As indicated by block 442, a step is performed of  
receiving a second user-initiated event in which a portion  
5 of the forward graphical book representation is selected.  
In a preferred embodiment, the portion of the forward  
graphical book representation selected in this step is  
within the front cover portion of the forward graphical book  
representation. The reception of the second user-initiated  
10 event ends the execution of the library graphical user  
interface routine, and flow is directed to the routine to  
display pages of text from the second book. Here, steps are  
performed of reading machine-readable data from a machine-  
readable storage medium installed in the electronic book,  
15 the machine-readable data being representative of text from  
the second book, and displaying the text represented by the  
machine-readable data.

It is noted that the steps indicated by blocks 436 and  
440 can be repeated to allow the user to rotate through the  
20 plurality of books. When the first user-initiated event is  
received while a last of the plurality of books is  
displayed, the next title displayed is that of the first of  
the plurality of books.

It is preferred that steps of displaying and receiving  
25 user-initiated events all be performed using the touchscreen  
130 integrated in the electronic book. However, in  
alternative embodiments of the electronic book which include  
a series of buttons external to the touchscreen 130, any of  
the above-described user-initiated events may be received  
30 using these buttons.

FIGS. 27 and 28 show flow diagrams of an embodiment of  
the routine to display pages of text in the electronic book.  
The steps indicated in these flow diagrams are performed in  
one embodiment of the step indicated by block 402 in FIG.  
35 25.

0       Upon entering the routine, a step of displaying a  
current page of the book is performed as indicated by block  
450. The current page includes text from the current page  
of the book, a graphical display of a number of pages  
remaining in the book, a display of a bookmark graphic if  
5 there is a bookmark associated with the current page, a dog  
ear graphic if the current page is dog-eared, and a note  
marker icon if there is an annotation associated with the  
current page. Optionally, the current page includes  
graphics from the current page of the book.

10       After displaying the current page, a branching step is  
performed, as indicated by block 452, based upon any user-  
initiated events which are received. If a user-initiated  
event is received which selects a portion of the text, a  
step of marking the portion of the text is performed as  
15 indicated by block 454. The portion of the text can be  
marked either by color or grey scale highlighting the  
portion of the text, underlining the portion of the text, or  
displaying the portion of the text in a reverse video form.  
The portion of the text can be selected directly by a user  
20 sliding a finger or a stylus over the portion of the text.  
Alternatively, the portion of the text can be selected  
indirectly by a menu selection technique.

After the portion of the text has been marked, a step  
of displaying an option selection dialog box is performed as  
25 indicated by block 456. The option selection dialog box  
provides a plurality of options to the user, including a  
note capture option, a highlighting option, a quote capture  
option, and a set bookmark option.

As indicated by block 460, a step of receiving a user-  
30 initiated event indicative of a selection of one of the  
options is performed. Based upon the selection, a branching  
step is performed as indicated by block 462. If the note  
capture option is selected, then a step of executing an  
annotation subroutine is performed as indicated by block  
35 464. If the quote capture option is selected, then a step

0 of executing a quote capture subroutine is performed as  
indicated by block 466. If the highlighting option is  
selected, then a step of executing a highlighting subroutine  
is performed as indicated by block 470. If the set bookmark  
option is selected, then a step of executing a bookmark  
5 subroutine is performed as indicated by block 472.

Upon completing the execution of either the annotation  
subroutine, the quote capture subroutine, the highlighting  
subroutine, or the bookmark subroutine, a step of  
determining whether a pacing mode is active is performed as  
10 indicated by block 474. If the pacing mode is inactive,  
then flow of the routine is directed back to block 452 which  
performs a branching step based upon a received user-  
initiated event. If the pacing mode is active, then a step  
of determining whether a highlighting mode is active is  
15 performed as indicated by block 476. If the highlighting  
mode is active then a step of scrolling a highlight across  
the current page is performed as indicated by block 480.  
Scrolling the highlight across the current page allows  
pacing of a user's scanning across the current page. A user  
20 can activate the highlighting mode to help enhance his or  
her reading speed.

The highlight which is scrolled across the page can be  
in the form of either a color or grey scale highlight, an  
underlining of text, or a reverse video form of text. If  
25 the touchscreen 130 is capable of selective backlighting,  
then the highlight can be in the form of a selective  
backlighting of a reduced portion of the touchscreen 130.

After scrolling the highlight across the current page  
in block 480 or if the highlighting mode is inactive, then a  
30 step of determining whether it is time for displaying a  
subsequent page is performed as indicated by block 482. If  
the time has not yet come for displaying a subsequent page,  
then flow is directed back to block 452. If the time has  
arrived for displaying a subsequent page, then a step of  
35 updating the current page is performed as indicated by block

## 35

0 484. Next, a step of displaying a forward page turn in an  
animated matter is performed as indicated by block 486.  
This step includes displaying an animated sequence of images  
which simulates a forward flipping of a page. Flow of the  
routine is then directed back to block 450 to display the  
5 new current page.

With reference to block 452, if a user-initiated event  
is received indicative of the user selecting the note marker  
icon, then the step of executing the annotation routine  
indicated by block 464 is performed. Thereafter, subsequent  
10 steps are performed beginning with the step indicated by  
block 474.

With reference to the branching step performed in block  
452, if a dog ear user-initiated event is received, then a  
step of executing a dog ear routine is performed as  
15 indicated by block 490. If the user-initiated event is  
indicative of the user selecting the bookmark portion of the  
page, then a step of executing a bookmark management routine  
is performed as indicated by block 491. Thereafter,  
subsequent steps are performed beginning with the step  
20 indicated by block 474. Similarly, if no user-initiated  
events are received in block 452, then flow of the routine  
is directed to the step indicated by block 474.

If the user-initiated event is indicative of the user  
selecting the page back portion of the page, then flow from  
25 block 452 branches to a step of decrementing the current  
page as indicated by block 492. Further, a step of  
displaying a backward page turn in an animated matter is  
performed as indicated by block 494. This step includes  
displaying an animated sequence of images which simulates a  
30 backward flipping of a page. The steps indicated by blocks  
486 and 494 give the user the sense or feel that a page of  
information is being turned in place, carrying forward the  
familiar paradigm of turning the page on a standard paper  
book.

35 As indicated by block 496, a step of determining

0 whether the new current page is the title page is performed  
after the step of block 494. If the new current page is the  
title page, then execution of the routine to display pages  
of text in the electronic book is completed as indicated by  
block 500. If the new current page is any page but the  
5 title page, then flow of the routine is directed back to  
block 450 wherein a step of displaying the new current page  
is performed.

If the user-initiated event is indicative of the user  
selecting the advance page portion of the page, then flow is  
10 directed from the step indicated by block 452 to a step of  
incrementing the current page as indicated by block 502.  
Further, a step of displaying a forward page turn in an  
animated matter is performed as indicated by block 504.  
Flow of the routine is then directed back to block 450  
15 wherein the new, incremented current page is displayed.

FIG. 29 is a flow diagram of steps performed to display  
a current page in the electronic book. These steps  
constitute one embodiment of a method of performing the step  
indicated by block 450 in FIG. 27.

20 As indicated by block 510, a step of displaying text  
from the current page of the book is performed. The text is  
displayed in accordance with a primary font parameter and a  
primary size parameter. If there is any highlighting  
associated with a portion of the text on the current page,  
25 then a step of displaying the portion of the text in a  
highlighted manner is performed as indicated by block 512.  
If any graphical information is included in the current  
page, then a step of displaying the graphical information is  
performed as indicated by block 513.

30 As indicated by block 514, a step of graphically  
displaying a number of pages remaining in the book is  
performed. The number of pages remaining in the book can be  
displayed in the sixth portion 188 of the touchscreen 130 as  
illustrated in FIG. 4. The number of pages remaining in the  
35 book can be graphically displayed using either an image of a

0 number of pages, a dark line as a drop shadow, or a group of  
parallel lines to indicate relative depth by page number in  
a given document. When the current page is one of the early  
pages in the book, the drop shadow or graphical image depth  
is relatively deep, indicating that there is a significant  
5 portion of the book remaining to be read. When the current  
page is near the middle of the book, the drop shadow or  
graphical image depth is half as deep. When nearing the end  
of the book, the drop shadow or graphical image depth  
becomes very thin indicating that the reader is almost at  
10 the end of the book. As a result, the user can determine at  
a glance how much of the book has been read, and their  
relative position within the book just as a standard paper  
book. As an alternative to using a top portion of the  
touchscreen for graphically displaying the number of pages  
15 remaining in the book, a side edge and/or a bottom edge of  
the touchscreen 130 can be utilized to provide this  
graphical display.

As indicated by block 516, a step of determining if a  
bookmark is associated with the current page is performed.  
20 If a bookmark is associated with the current page, then a  
step of displaying a bookmark graphic is performed as  
indicated by block 520.

As indicated by block 522, a step of determining if the  
current page is dog-eared is performed. If the current page  
25 is dog-eared, then a step of displaying a dog ear graphic is  
performed as indicated by block 524.

As indicated by block 526, a step of determining  
whether an annotation exists for the current page is  
performed. If there is an annotation associated with the  
30 current page, then a step of displaying a note marker icon  
is performed as indicated by block 530.

FIG. 30 is a flow diagram of steps performed in an  
embodiment of an annotation routine. Such an annotation  
routine is executed in the step indicated by block 464 in  
35 FIG. 28.

38

0       As indicated by block 540, a step of displaying a  
window for displaying the annotation is performed. As  
indicated by block 542, a step of displaying a soft keyboard  
on the touchscreen 130 is performed. The soft keyboard is  
provided to receive a plurality of keystroke events to form  
5       the annotation.

After displaying the soft keyboard and the annotation  
window, a step of receiving a keystroke event is performed  
as indicated by block 544. As indicated by block 546, a  
branching operation is performed based upon the keystroke  
10       event received in block 544. If the keystroke event is  
indicative of the user selecting either an alphanumeric key  
or a symbolic key on the soft keyboard, then a step of  
displaying a character associated with the key is performed  
as indicated by block 560. The character associated with  
15       the key is displayed within the annotation window. After  
displaying the character, flow of the routine is directed  
back to block 544 wherein a subsequent keystroke event is  
received.

Referring back to the branching step indicated by block  
20       546, if the keystroke event is indicative of a user  
selecting the close key from the soft keyboard, then a step  
of closing the soft keyboard is performed as indicated by  
block 562. A step of closing the annotation window is also  
performed, as indicated by block 564. As indicated by block  
25       566, a step of displaying a note marker icon on the page is  
performed. Thereafter, execution of the annotation  
subroutine is completed.

With reference again to the branching step performed in  
block 546, if the keystroke event is indicative of the user  
30       selecting the notes collection key, then a step of  
communicating the annotation to an external personal  
computer is performed as indicated by block 570. After  
communicating the annotation to the personal computer, flow  
of the routine is directed back to block 544 wherein a  
35       subsequent keystroke event is received.



0        FIG. 31 is a flow diagram of steps performed in an embodiment of a quote capture subroutine. Such a quote capture subroutine can be performed to provide the step indicated by block 466 in FIG. 28.

5        Prior to entering the quote capture subroutine, a user-initiated event was received in the electronic book which selects a portion of the text displayed on the touchscreen. After receiving the user-initiated event, a plurality of text marking options, including a quote capture option, is displayed, and a user-initiated event indicative of a user  
10       selecting the quote capture option is received.

      As indicated by block 580, a step of storing quote data representative of the portion of the text is performed. The quote data is stored in the internal machine-readable storage medium 154 illustrated in FIG. 3.

15       As indicated by block 582, a step of storing source data which identifies the source of the quote data is performed. The source data can be representative of the author of the book, the title of the book, a copyright date of the book, and/or a publisher of the book. The source  
20       data is stored in the internal machine-readable storage medium 154 from FIG. 3.

      As indicated by block 584, a step is performed of maintaining the quote data and the source data in the internal machine-readable storage medium when the removable  
25       machine-readable storage medium is removed from the electronic book. As a result of this step, subsequent steps can be performed based upon the quote data and the source data when the removable machine-readable storage medium is removed. Specifically, a step of retrieving the quote data  
30       and the source data from the internal machine-readable storage medium can be performed when the removable machine-readable storage medium is removed from the electronic book. Thereafter, a step of displaying the portion of the text represented by the quote data and source information  
35       represented by the source data can be performed.

## 40

0        FIG. 32 is a flow diagram of steps performed in an embodiment of a dog ear subroutine. Such a dog ear subroutine is executed in the step indicated by block 490 in FIG. 27.

5        As indicated by block 590, a step is performed of determining a duration in which a dog ear portion of the touchscreen is held. A step of comparing the duration to a predetermined threshold is performed as indicated by block 592. The predetermined threshold can be about a second. If the duration is less than the predetermined threshold, then  
10       a step of determining whether the current page has a dog ear is performed as indicated by block 594. If the current page does not have a dog ear, then a step of storing an indication that the current page be dog-eared is performed as indicated by block 596. Further, a step of displaying a  
15       dog ear graphic in an upper corner portion of the touchscreen 130 is performed as indicated by block 600. Thereafter, execution of the dog ear subroutine is completed.

20       With reference to blocks 592 and 594, if the duration is greater than or equal to the predetermined threshold or if the current page is already dog-eared, then a step of displaying a dog-eared dialog box is performed as indicated by block 602. Within the dog-eared dialog box, a list of all marked pages is displayed. Further, an option to show  
25       marks corresponding to all of the marked pages along an edge of each page is displayed.

30       As indicated by block 604, a user-initiated event is received. As indicated by block 606, a branching step is performed based upon the user-initiated event received. If the user-initiated event is indicative of a user selecting a page number from the list of marked pages, then a step of setting the current page to the selected page number is performed as indicated by block 610. If the user-initiated event is indicative of the user selecting the marking  
35       option, then a step of displaying marks corresponding to the

0 dog-eared pages along an edge of the page is performed as indicated by block 612.

FIG. 33 is a flow diagram of steps performed in an embodiment of a pacing control subroutine. The pacing control subroutine is executed in the step indicated by  
5 block 472 in FIG. 25.

As indicated by block 620, a step of determining a number of pages remaining in the book is performed. As indicated by block 622, a step of determining a current reading pace of the user is performed.

10 Based upon the number of pages remaining in the book, a step of calculating one or more estimated completion times is performed as indicated by block 624. A first estimated completion time can be calculated by dividing the number of words or pages remaining in the book by the current reading  
15 pace of the user. As a result, the first estimated completion time estimates how long it would take the user to complete the book at his or her current reading pace. A second estimated completion time is calculated by dividing the number of words or pages remaining in the book by a  
20 desired reading pace. The second estimated completion time estimates how long it would take the user to complete the book at the desired reading pace.

As indicated by block 626, a step of displaying each estimated completion time is performed. Each estimated  
25 completion time can be displayed within a corresponding sentence as illustrated in FIG. 15.

As indicated by block 630, a step of calculating a necessary reading pace to satisfy a predetermined reading goal is performed. The predetermined reading goal can be in  
30 the form of a time duration within which a user wishes to complete the pages remaining in the book. Here, the necessary reading pace is calculated by dividing the number of pages remaining in the book by the time duration. A step of displaying the necessary reading pace to satisfy the  
35 reading goal is then performed as indicated by block 632.

0       As indicated by block 634, a step of displaying one or more graphical pacing controls is performed. As illustrated in FIG. 15, the one or more graphical pacing controls can include a graphical slider bar such as the graphical slider bar 294 used for modifying the desired reading pace, and a  
5       graphical switch such as the graphical switch 296 which is used for enabling and disabling an automatic pacing of the text using a pacing routine.

      As indicated by block 636, a user-initiated event is received. As indicated by block 640, if the user-initiated  
10      event is indicative of the user selecting the page back portion of the touchscreen 130, then execution of the pacing control subroutine is terminated. Upon terminating the pacing control subroutine, the system control page is displayed on the touchscreen 130.

15      If the user-initiated event is not indicative of the user selecting the page back portion, then a step of updating a pacing parameter based on the user-initiated event is performed as indicated by block 642. Examples of the pacing parameter include the desired reading pace and  
20      the reading goal. After updating the pacing parameter, flow of the subroutine is directed back to block 624 to recalculate an estimated completion time and the necessary reading pace.

      FIG. 34 is a flow diagram of steps performed in an embodiment of the font selection subroutine. The font  
25      selection subroutine is executed in block 414 in the event loop of FIG. 25.

      As indicated by block 650, a step of displaying a plurality of words using a corresponding plurality of  
30      combinations of different fonts and different sizes is performed. More specifically, each word is displayed using a specific font and a specific size in accordance with the combination corresponding thereto. Optionally, the step of displaying the plurality of words can include displaying a  
35      respective font name for each of the combinations. As

## 43

0 another option, the step of displaying the plurality of words can include displaying a single textual expression using the corresponding plurality of combinations.

As indicated by block 652, a step of receiving a user-initiated event indicative of the user selecting one word of  
5 the plurality of words is performed. This selection indicates which font/size combination is desired by the user.

As indicated by block 654, a step of updating a primary font parameter and a primary size parameter is performed.  
10 The primary font parameter and the primary size parameter are updated in accordance with the font/size combination selected by the user. As indicated by block 656, a step of automatically returning to displaying the title page is performed after receiving the user-initiated event selecting  
15 the one word. Thereafter, a subsequent step of displaying text of a book includes displaying the text using the primary font in a size at least the primary size.

FIG. 35 is a flow diagram of steps performed in an embodiment of the system control subroutine. The system  
20 control subroutine is executed in the step indicated by block 416 in the event loop of FIG. 25.

As indicated by block 660, a step of displaying a plurality of graphical controls for setting system parameters is performed. The system parameters can include  
25 display parameters such as a contrast parameter, a tint parameter, and a color parameter. The system parameters can also include a sound parameter.

As indicated by block 662, a step of receiving a user-initiated event is performed. If the user-initiated event  
30 is indicative of the user selecting the page back portion of the touchscreen, as indicated by block 664, then execution of the system control subroutine is completed. For other user-initiated events, a step of updating a system parameter is performed as indicated by block 668.

35 FIG. 36 is a block diagram of a system for encoding a

0 book for reading using an electronic book having an internal  
machine-readable dictionary. An interface 800 receives data  
representative of text and graphical information of the  
book. The interface 700 can take a variety of different  
forms, such as a wireline communication interface, a  
5 wireless communication interface, or an interface to a mass  
storage device.

The system includes an encoder 702 in communication  
with the interface 700. The encoder 702 encodes first  
machine-readable data representative of a plurality of words  
10 not included in the internal machine-readable dictionary to  
provide a customized dictionary. The encoder 702 further  
encodes second machine-readable data representative of the  
text of the book. The second machine-readable data includes  
a plurality of pointers which point to a corresponding  
15 plurality of words in the machine-readable dictionary and  
the customized dictionary to provide the text. The encoder  
702 also encodes third machine-readable data representative  
of the graphical information.

Optionally, the encoder 702 further encodes fourth  
20 machine-readable data for modifying a spoken auditory  
display of the text using the voice synthesizer 162. The  
fourth machine-readable data can be indicative of an  
alternative pronunciation, an alternative emphasis, and/or  
an alternative voice of at least one word of the text.

25 The system further includes an interface 704 in  
communication with the encoder 702. The interface 704  
communicates the first machine-readable data, the second  
machine-readable data, the third machine-readable data, and  
the fourth machine-readable data to the electronic book.  
30 The interface 704 further communicates an access  
authorization level for reading at least one of the first,  
second, third, and fourth machine-readable data, to the  
electronic book. The access authorization level can be a  
single-book level which limits reading of the book to a  
35 specific electronic book, a single-medium level which limits

45

0 reading of the book to a specific machine-readable storage  
medium, and a single-read level which limits reading of the  
book to a single read and inhibits subsequent readings of  
the book.

5 The interface 704 can communicate the machine-readable  
data directly to the electronic book via the data interface  
156, the RF modem 160, or the infrared transceiver 161.  
Alternatively, the interface 704 can communicate the  
machine-readable data to a machine-readable storage medium  
for installation in the electronic book.

10 If the access authorization level is a single-book  
level, the machine-readable data can be encoded in  
accordance with a public encryption key of an electronic  
book having a secret, private key. Here, the system  
receives the public encryption key for the electronic book  
15 and encodes the machine-readable data in accordance with the  
public encryption key before communicating the data to the  
electronic book. As a result, the machine-readable data is  
decodable only if the private key of the electronic book is  
known. As a result, reading of the book is limited to the  
20 electronic book having the private key.

If the access authorization level is a single-medium  
level, the machine-readable data can be encoded in  
accordance with a material characteristic of a machine-  
readable storage medium on which the data is stored. As a  
25 result, decoding of the machine-readable data is limited to  
the machine-readable storage medium.

The system can be formed by a box which attaches  
externally to a parallel port or a serial port on a personal  
computer programmed to encode the information to be  
30 delivered to the electronic book.

Thus, there has been described herein a concept, as  
well as several embodiments including preferred embodiments  
of a method and system for encoding a book for reading using  
an electronic book.

35 Because the various embodiments of the present

0 invention utilize stores a textual information in the form  
of a customized dictionary and pointers to the customized  
dictionary and an internal machine-readable dictionary, they  
provide a significant improvement in that the textual  
information can be stored efficiently for each book.

5 Additionally, the various embodiments of the present  
invention store an access authorization level for each book  
medium. The access authorization level is utilized to limit  
access to the information stored on the book medium.

10 It will be apparent to those skilled in the art that  
the disclosed invention may be modified in numerous ways and  
may assume many embodiments other than the preferred form  
specifically set out and described above.

Accordingly, it is intended by the appended claims to  
cover all modifications of the invention which fall within  
15 the true spirit and scope of the invention.

What is claimed is:



## 0 Claims

1. A method of encoding a book for reading by an electronic book having an internal machine-readable dictionary, the method comprising the steps of:

5 receiving data representative of text and graphical information of the book;

encoding first machine-readable data representative of a plurality of words to provide a customized dictionary which augments the internal machine-readable dictionary;

10 encoding second machine-readable data representative of the text, the second machine-readable data including a plurality of pointers which point to a corresponding plurality of words in the internal machine-readable dictionary and the customized dictionary;

15 encoding third machine-readable data representative of the graphical information; and

providing an access authorization level for reading at least one of the first machine-readable data, the second machine-readable data, and the third machine-readable data.

20

2. The method of claim 1 further comprising the step of encoding fourth machine-readable data for modifying a spoken auditory display of the text using a voice synthesizer.

25

3. The method of claim 1 wherein the access authorization level is a single-book level, the method further comprising the step of receiving a public encryption key for the electronic book, wherein at least one of the first machine-readable data, the second machine-readable data, and the third machine-readable data is encoded in accordance with the public encryption key to limit reading thereof to the electronic book having a private key associated therewith.

35

0           4.    The method of claim 1 wherein the access  
authorization level is a single-medium level, the method  
further comprising the step of receiving a material  
characteristic which identifies a machine-readable storage  
medium, wherein at least one of the first machine-readable  
5   data, the second machine-readable data, and the third  
machine-readable data is encoded in accordance with the  
material characteristic to limit decoding thereof to the  
machine-readable storage medium.

10           5.    The method of claim 1 wherein the access  
authorization level is a single-read level to inhibit a  
subsequent reading by the electronic book.

            6.    A system for encoding a book for reading by an  
15   electronic book having an internal machine-readable  
dictionary, the system comprising:  
            a first interface for receiving data representative of  
text and graphical information of the book;  
            an encoder in communication with the first interface,  
20   the encoder for encoding first machine-readable data  
representative of a plurality of words to provide a  
customized dictionary which augments the internal machine-  
readable dictionary, the encoder for encoding second  
machine-readable data representative of the text, the second  
25   machine-readable data including a plurality of pointers  
which point to a corresponding plurality of words in the  
internal machine-readable dictionary and the customized  
dictionary, the encoder for encoding third machine-readable  
data representative of the graphical information; and  
30           a second interface for communicating the first machine-  
readable data, the second machine-readable data, and the  
third machine-readable data to the electronic book, the  
second interface further communicating an access  
authorization level for reading at least one of the first  
35   machine-readable data, the second machine-readable data, and

0 the third machine-readable data.

7. The system of claim 6 wherein the encoder further encodes fourth machine-readable data for modifying a spoken auditory display of the text using a voice synthesizer.

5

8. The system of claim 7 wherein the fourth machine-readable data is indicative of an alternative pronunciation of at least one word of the text.

10 9. The system of claim 7 wherein the fourth machine-readable data is indicative of an alternative emphasis of at least one word of the text.

15 10. The system of claim 7 wherein the fourth machine-readable data is indicative of an alternative voice of at least one word of the text.

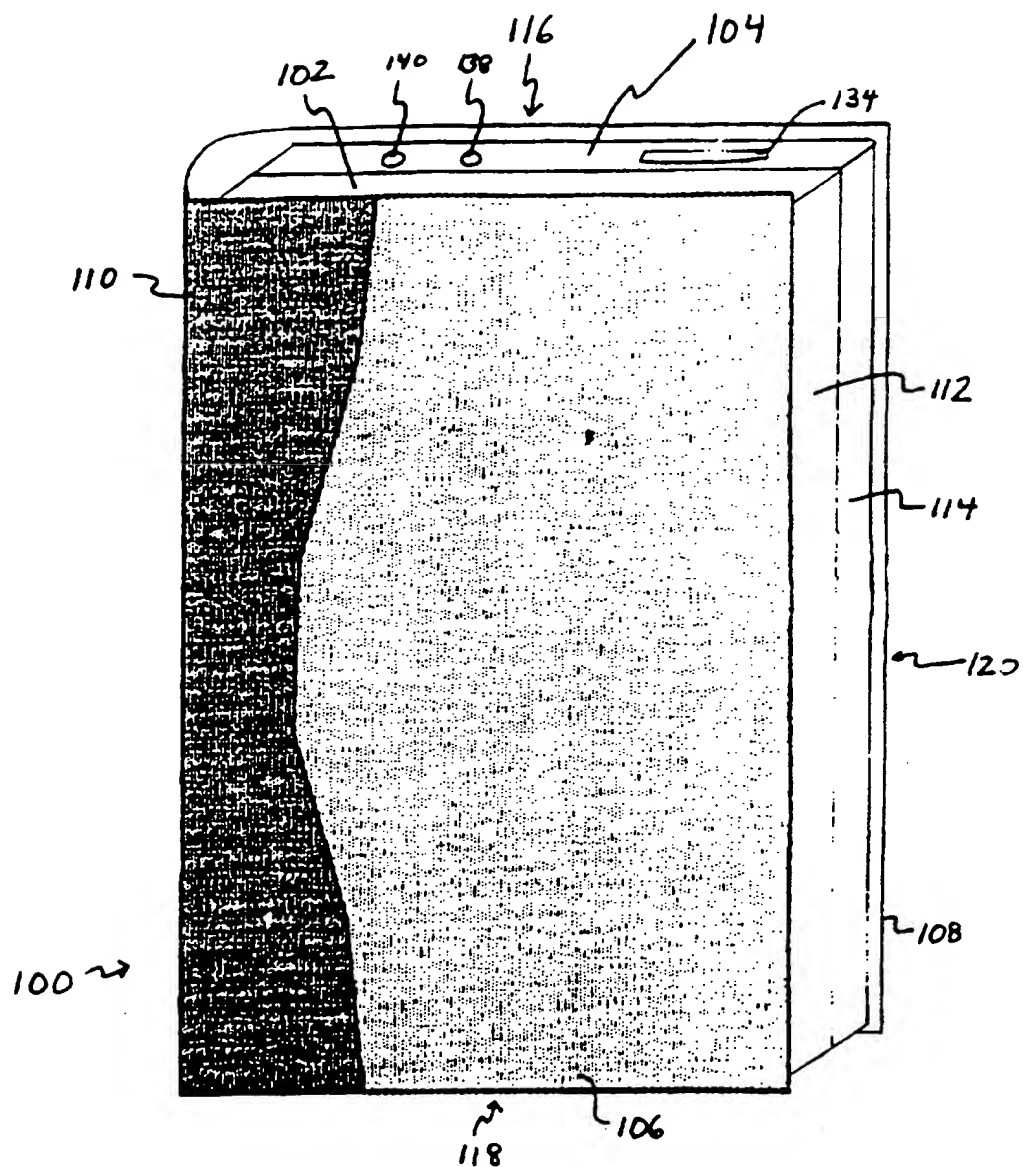
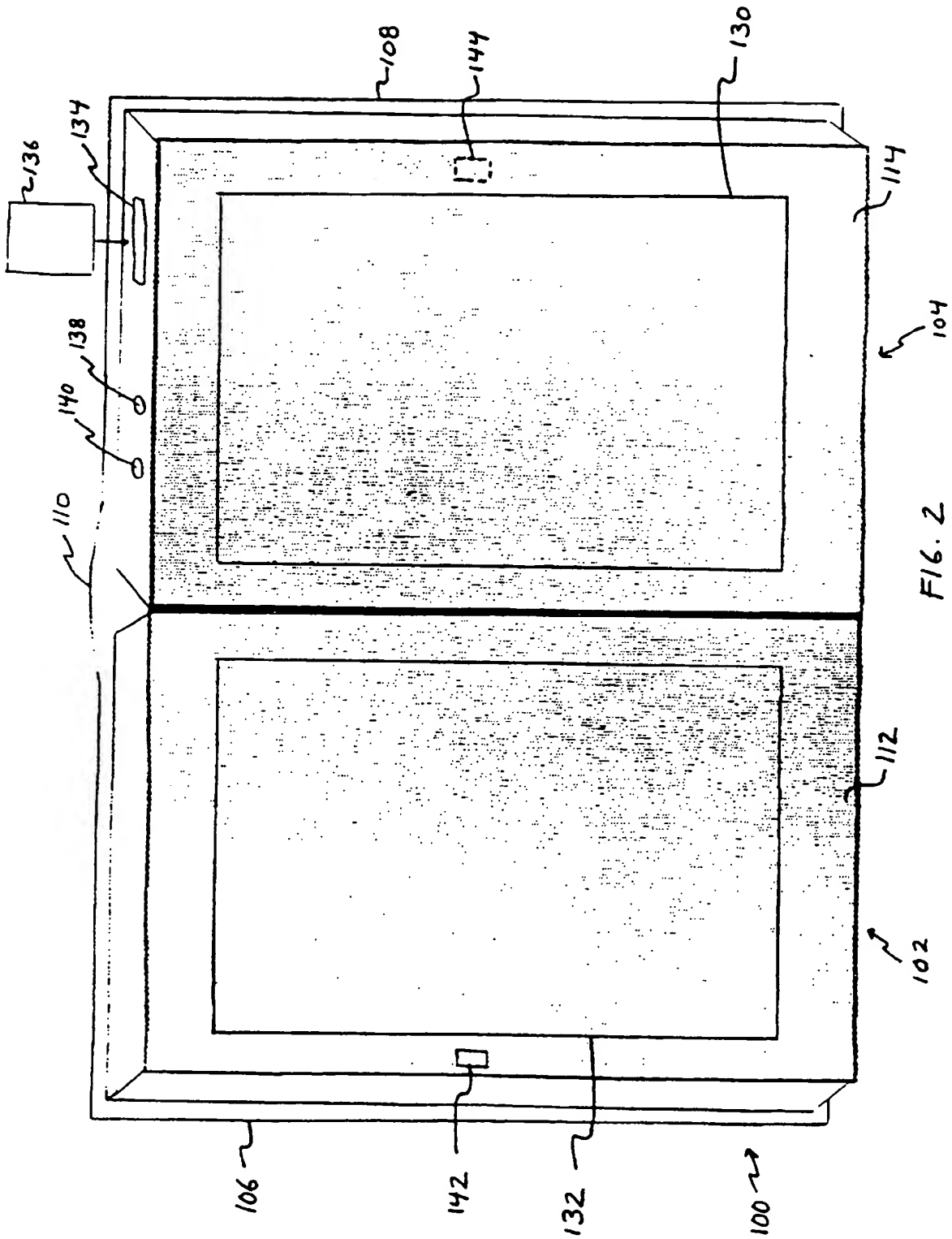


FIG. 1



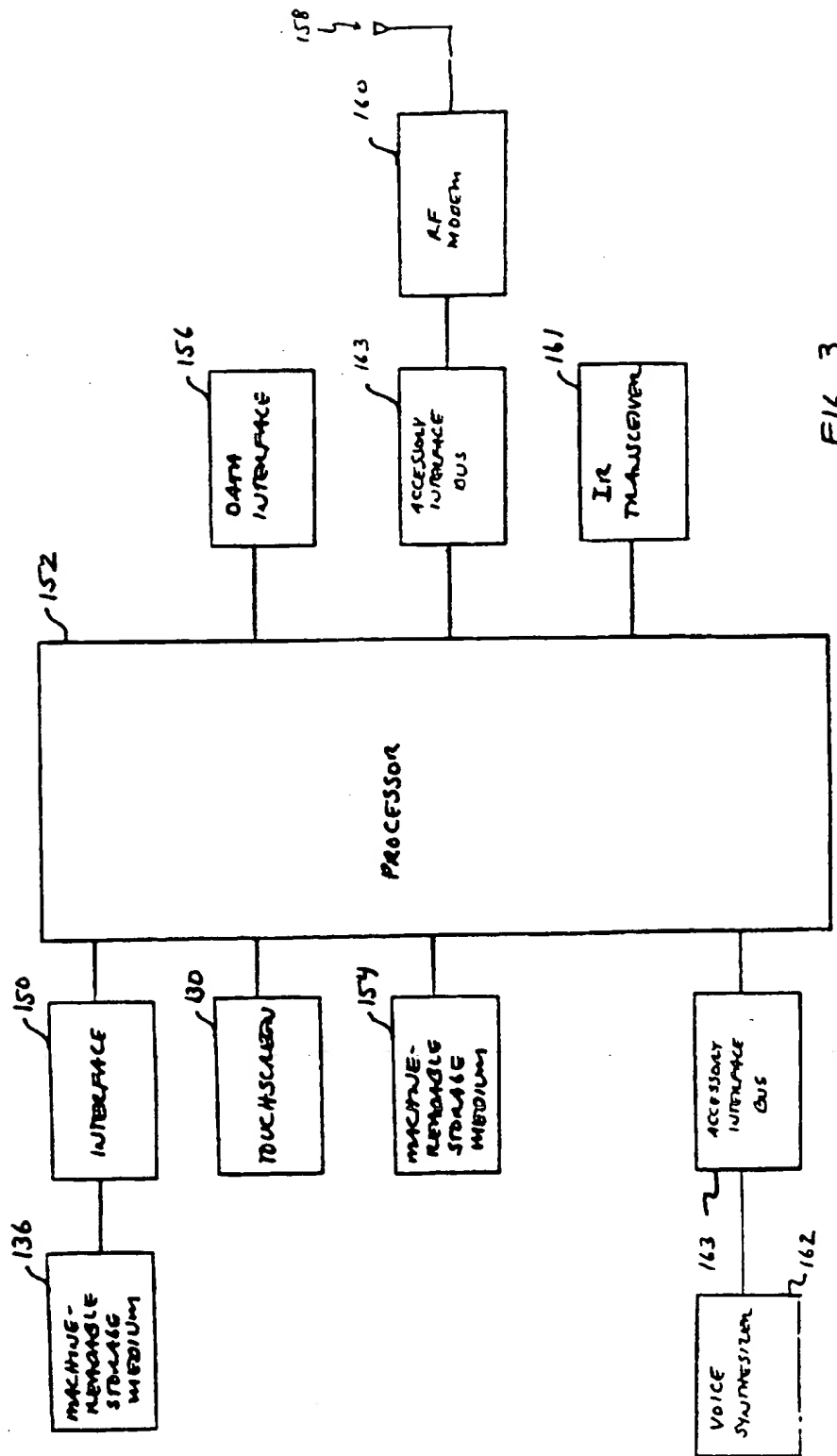


FIG. 3

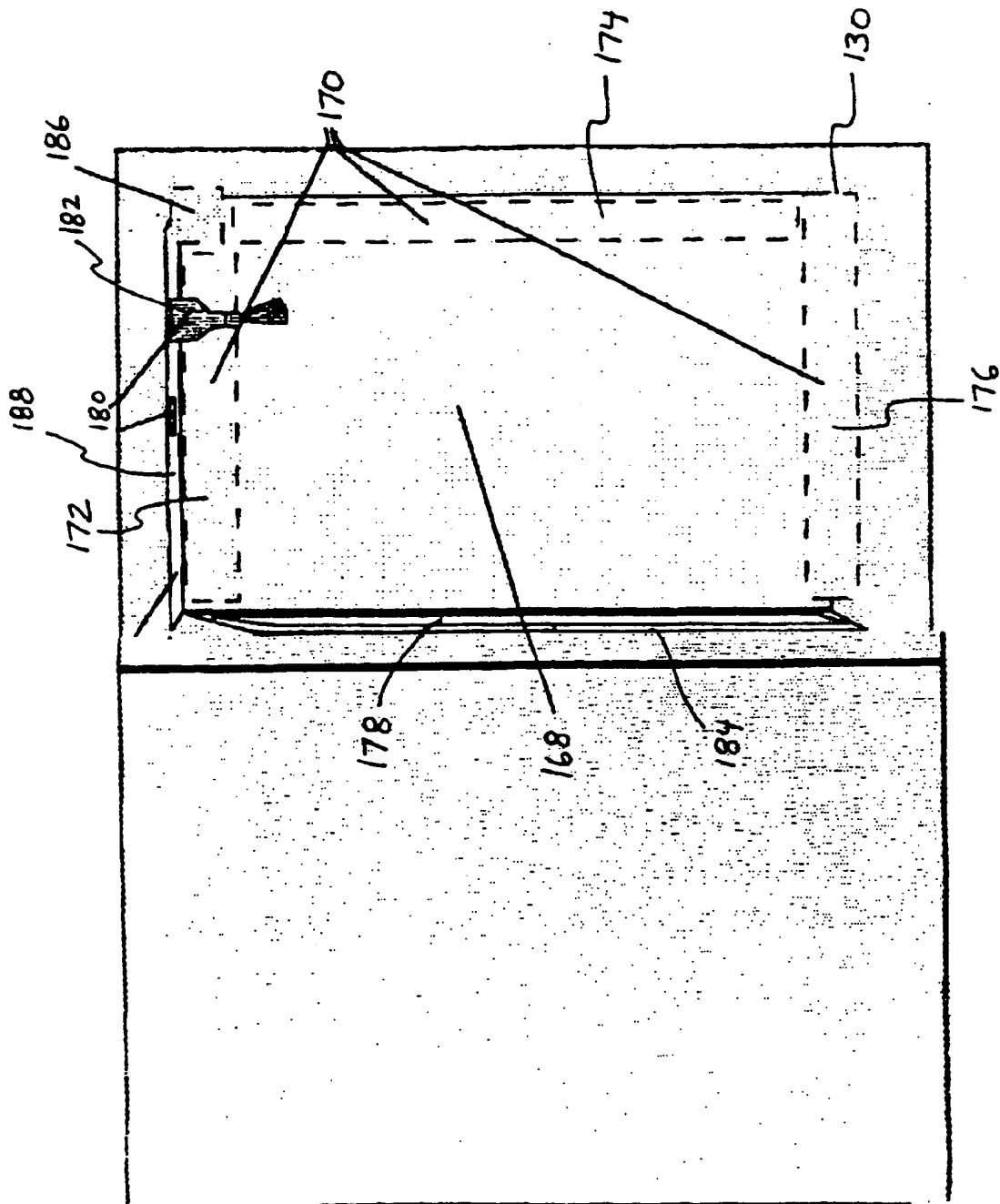


FIG. 4

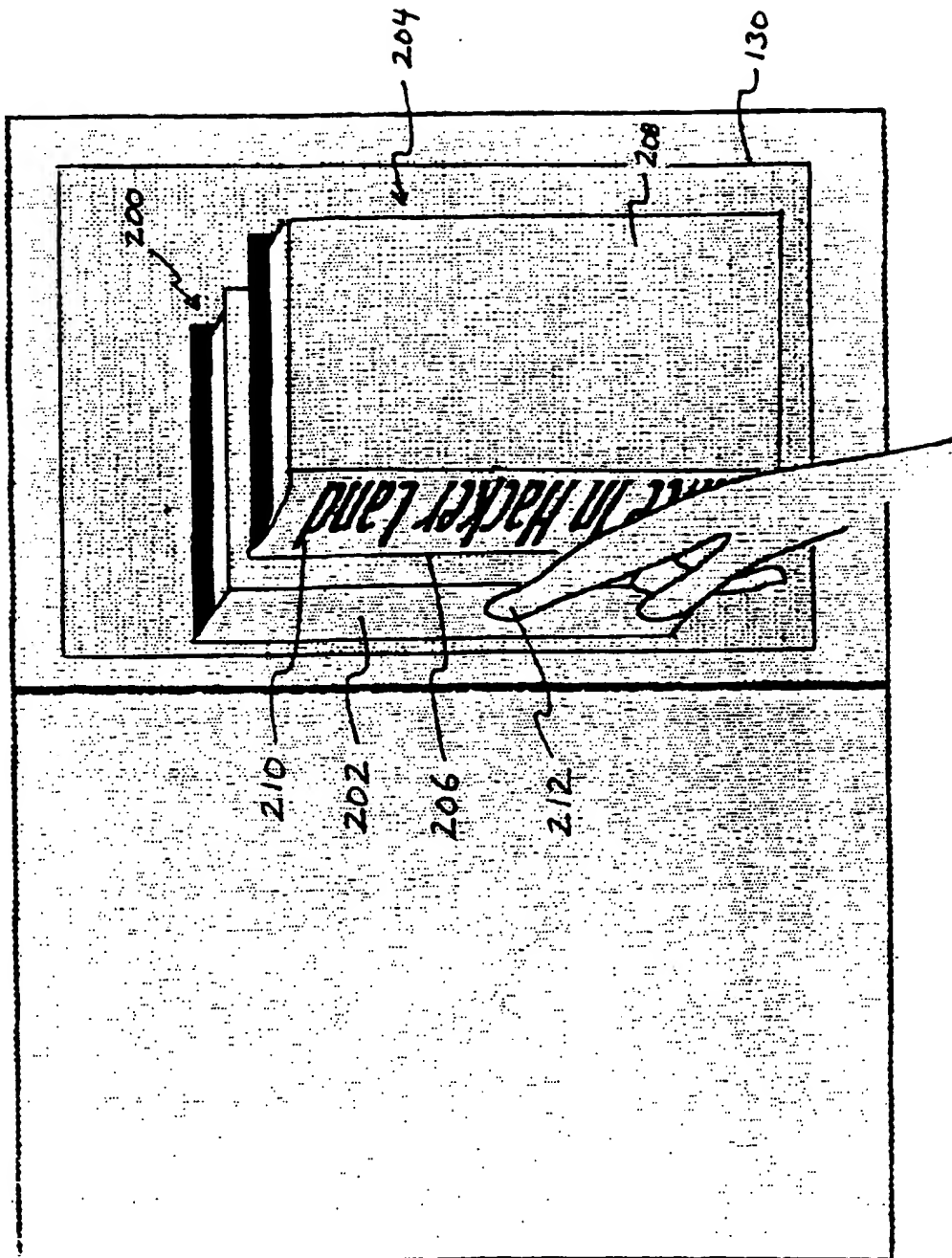


FIG. 5



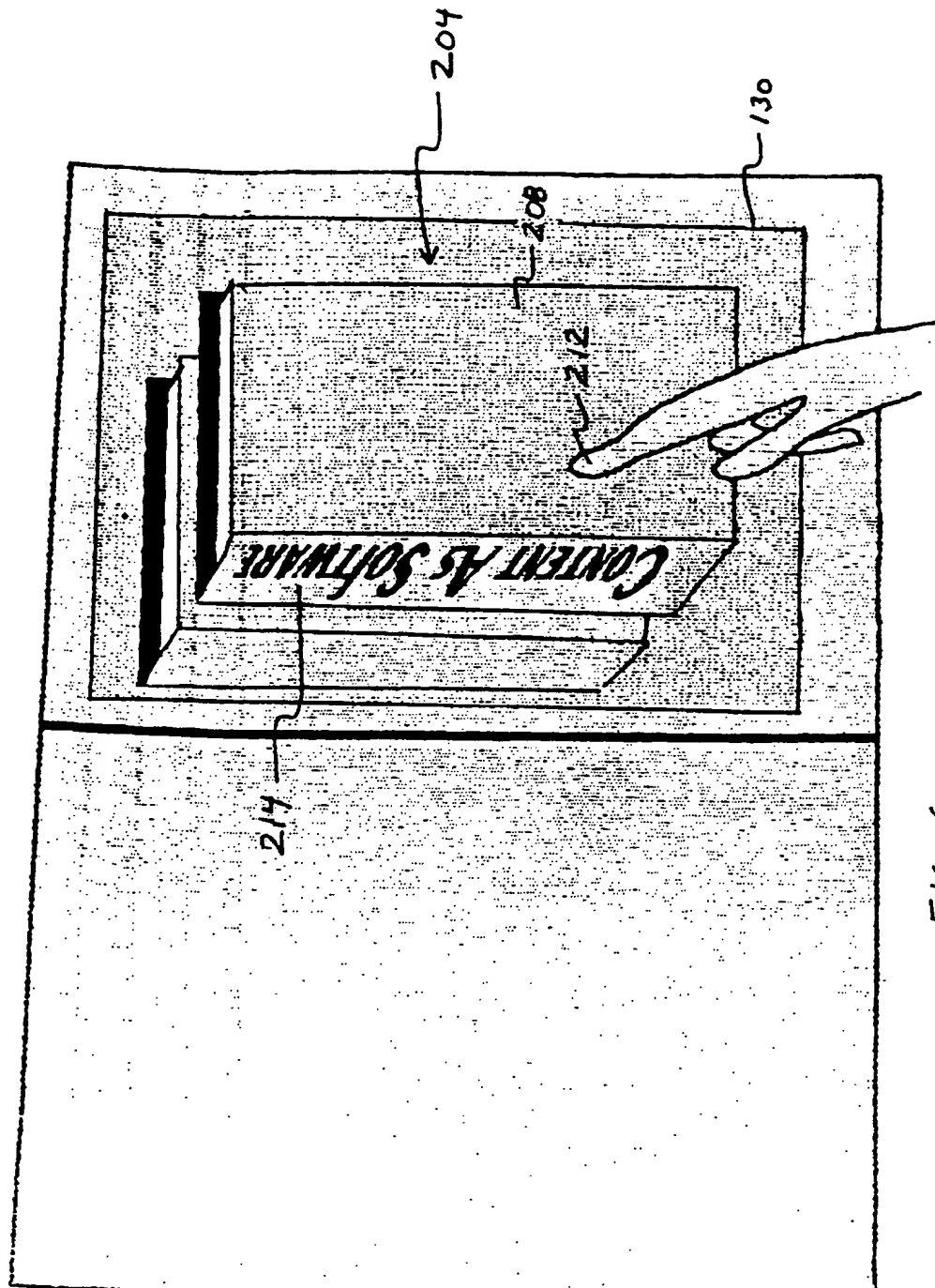
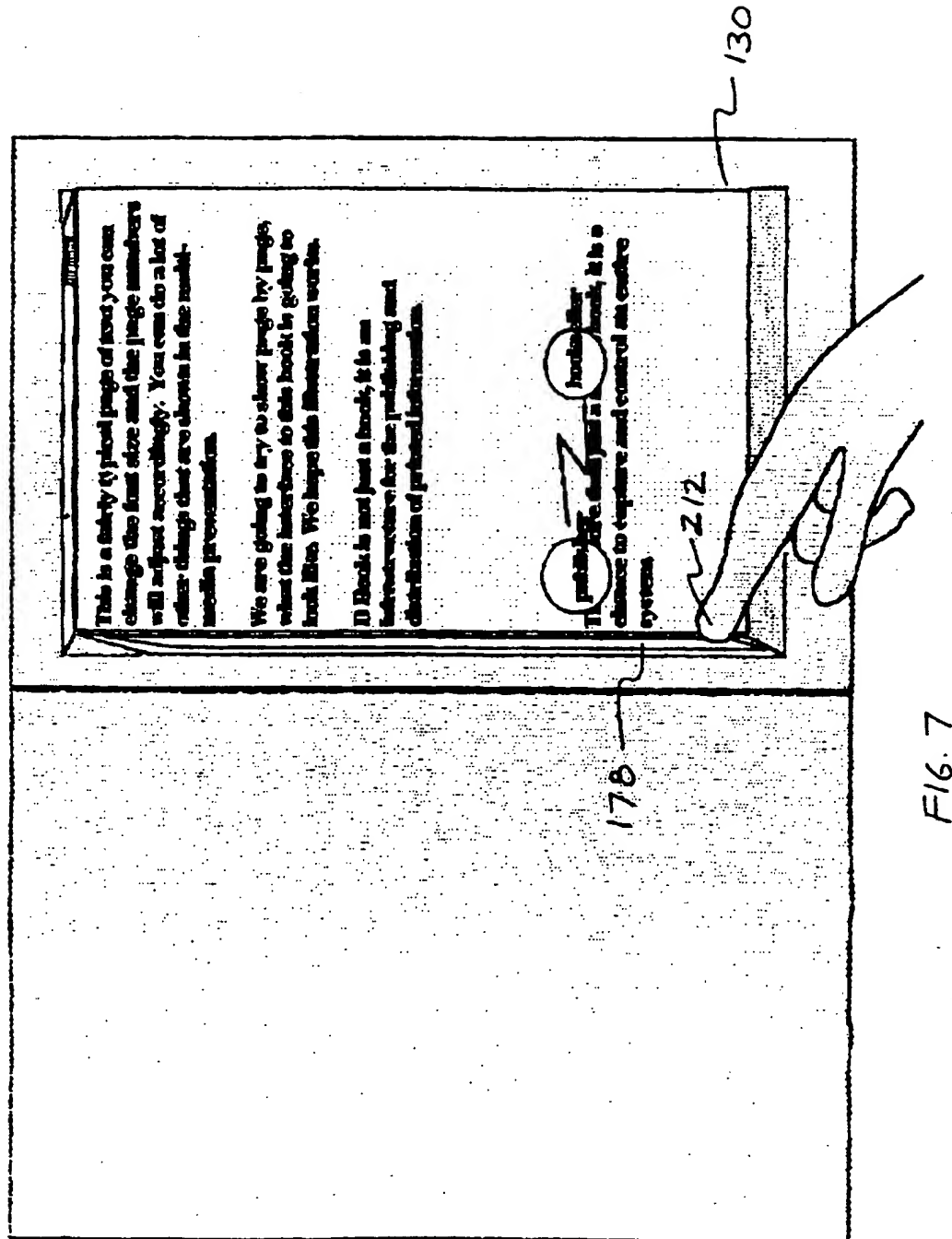


FIG. 6



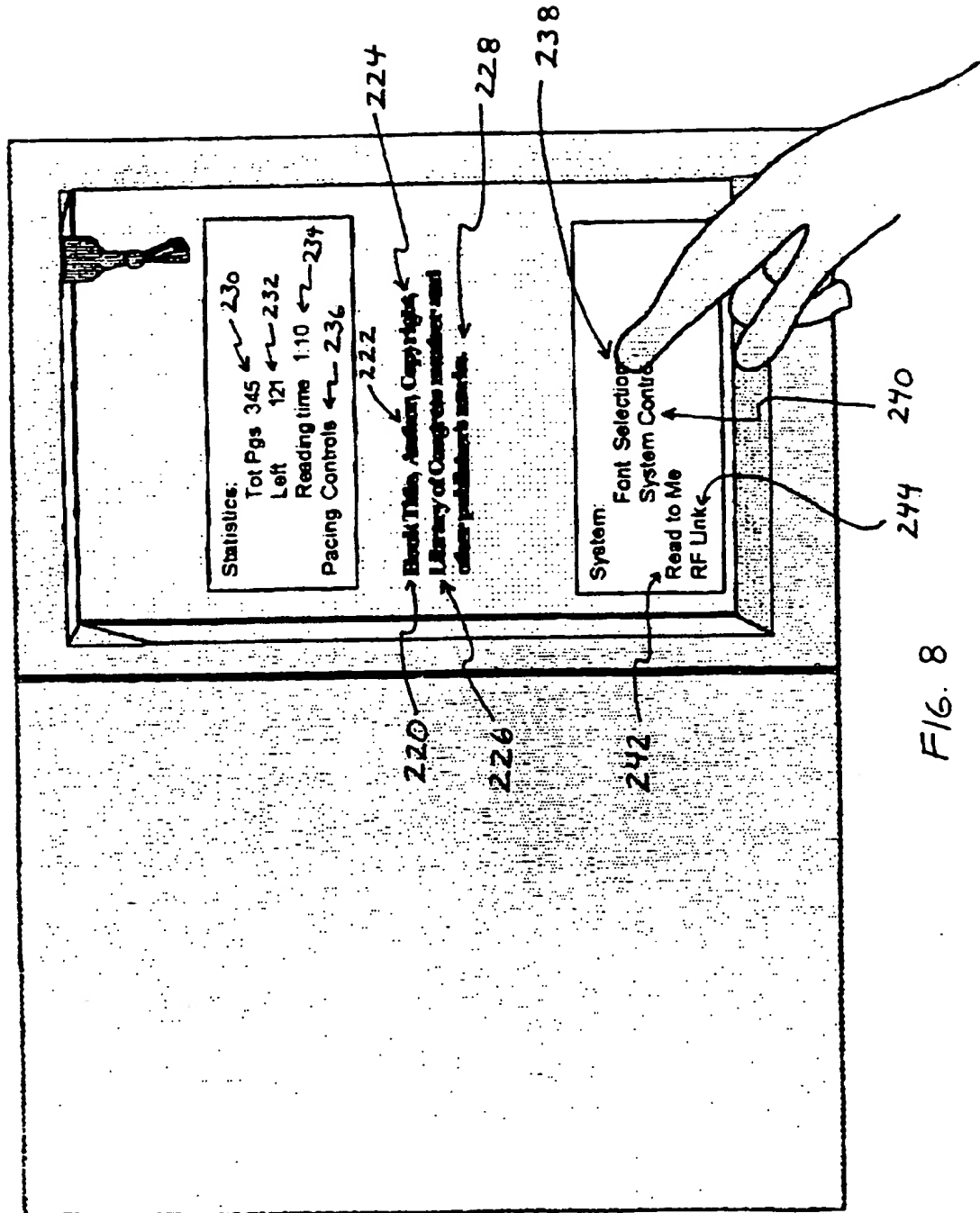


FIG. 8

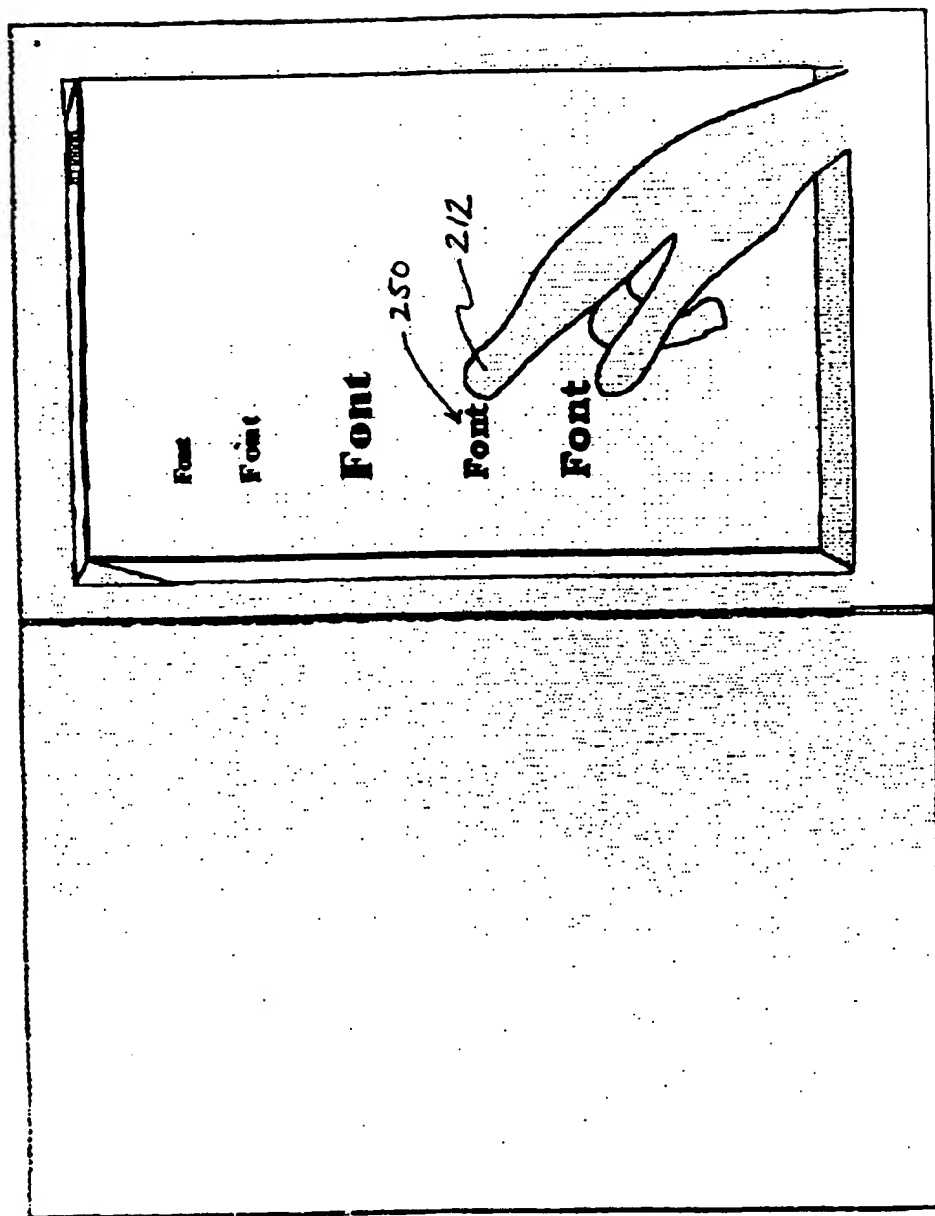


FIG. 9

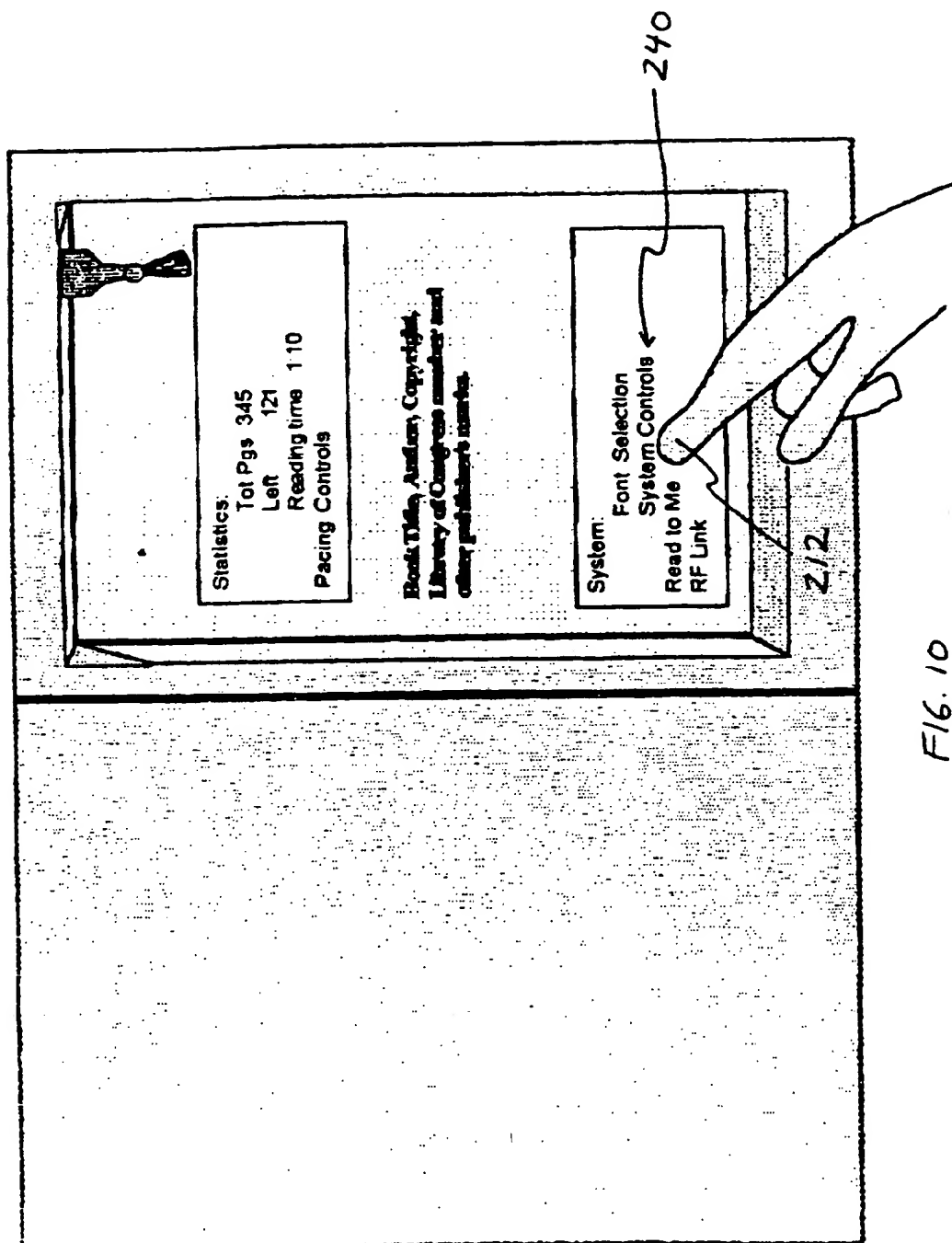


FIG. 10

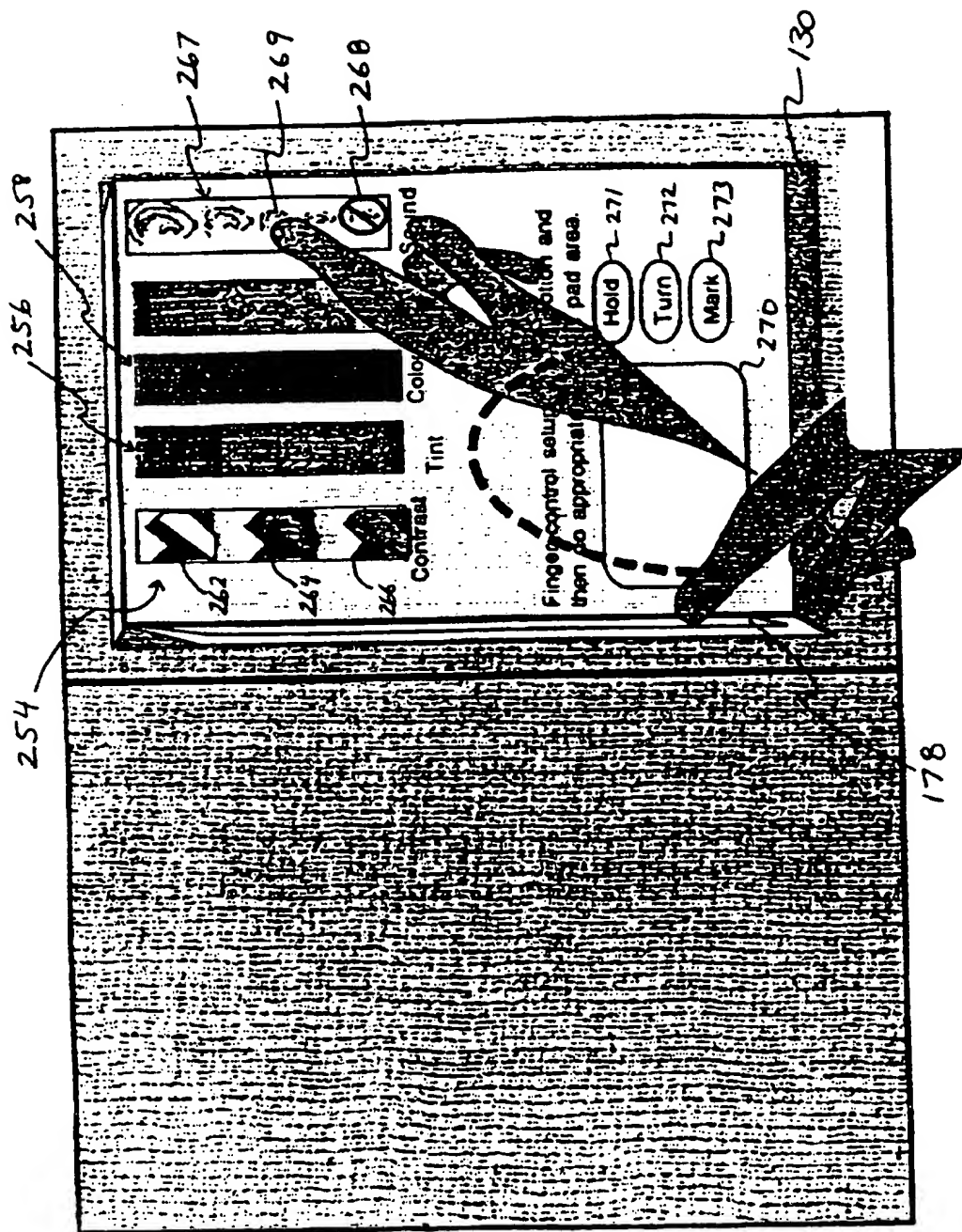


FIG. 11

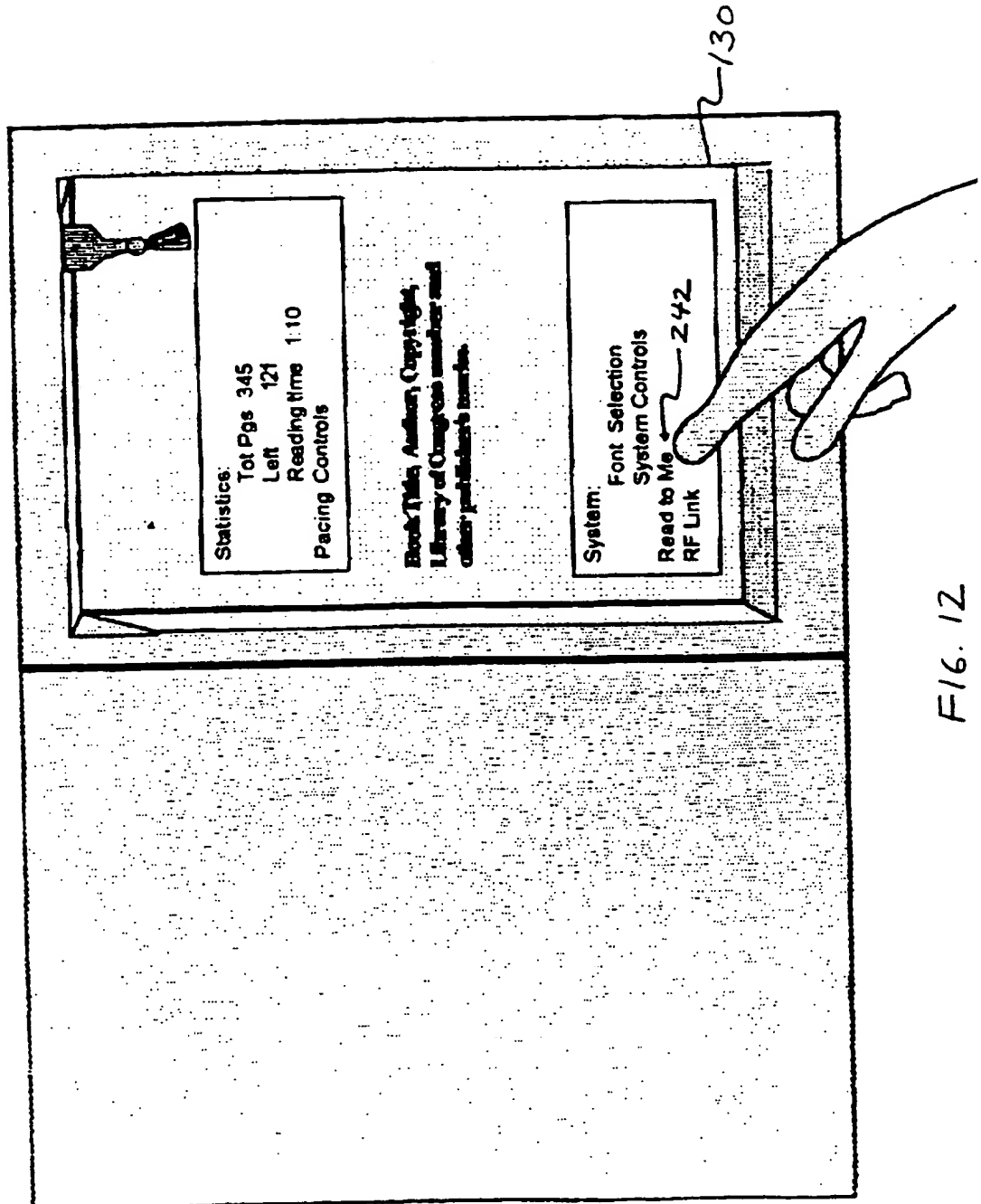
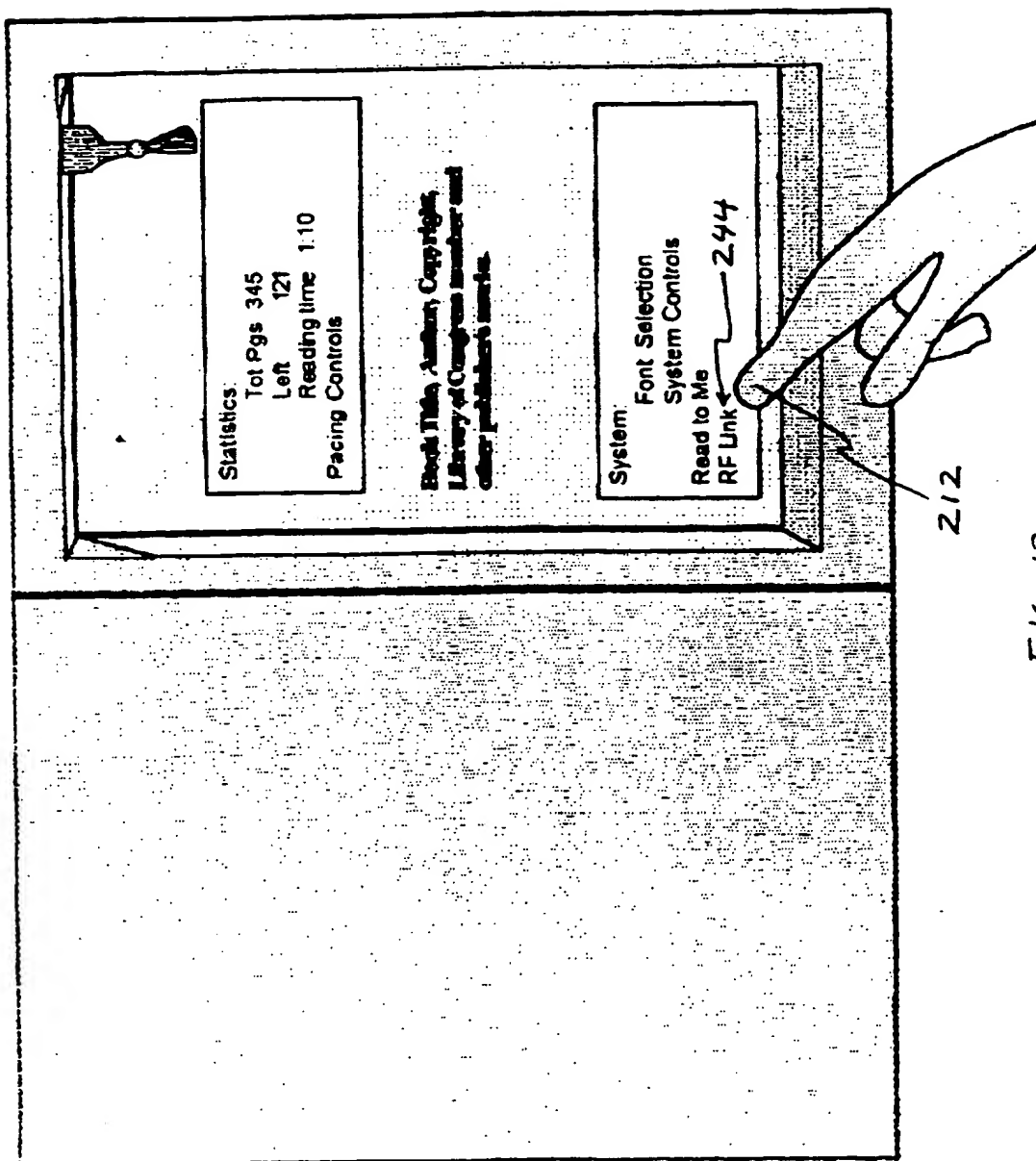


FIG. 12





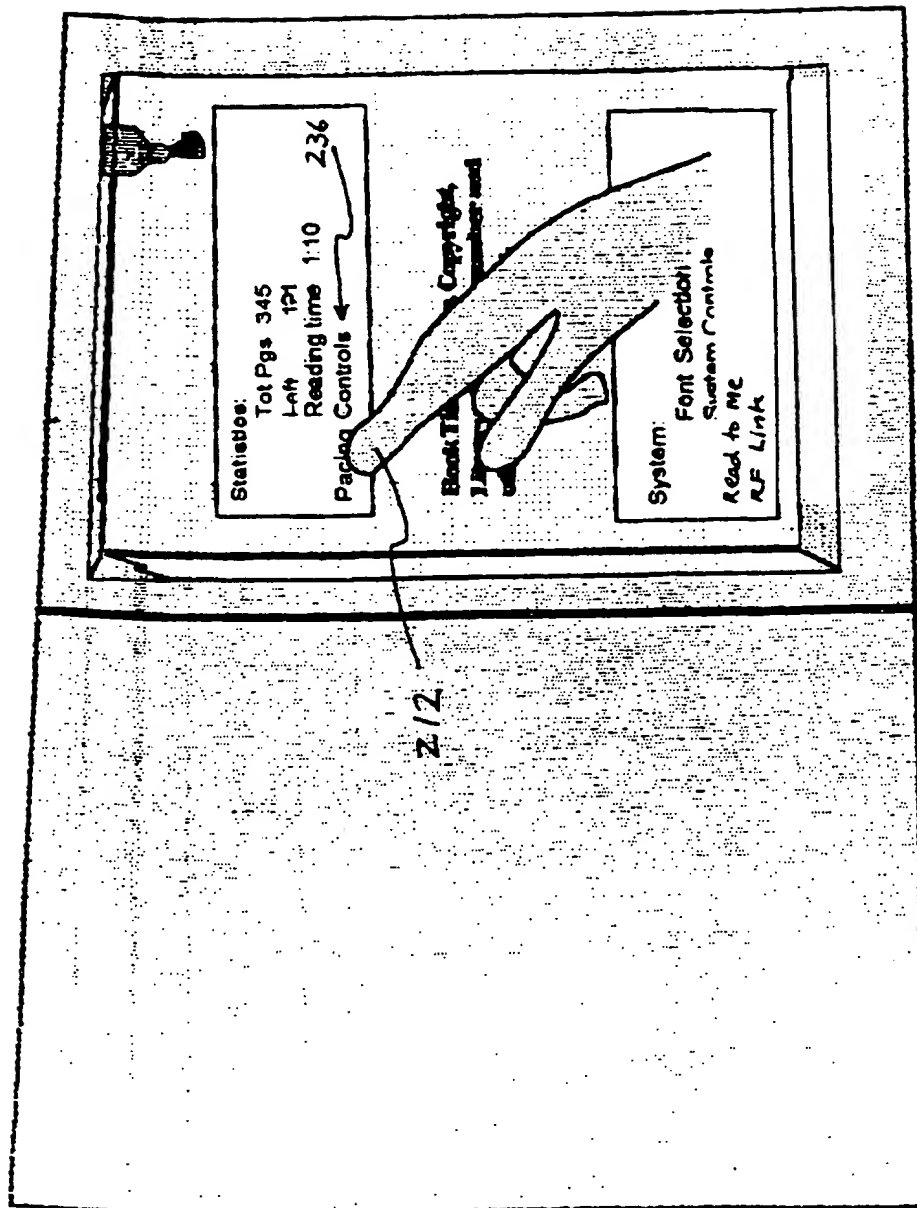


FIG. 14

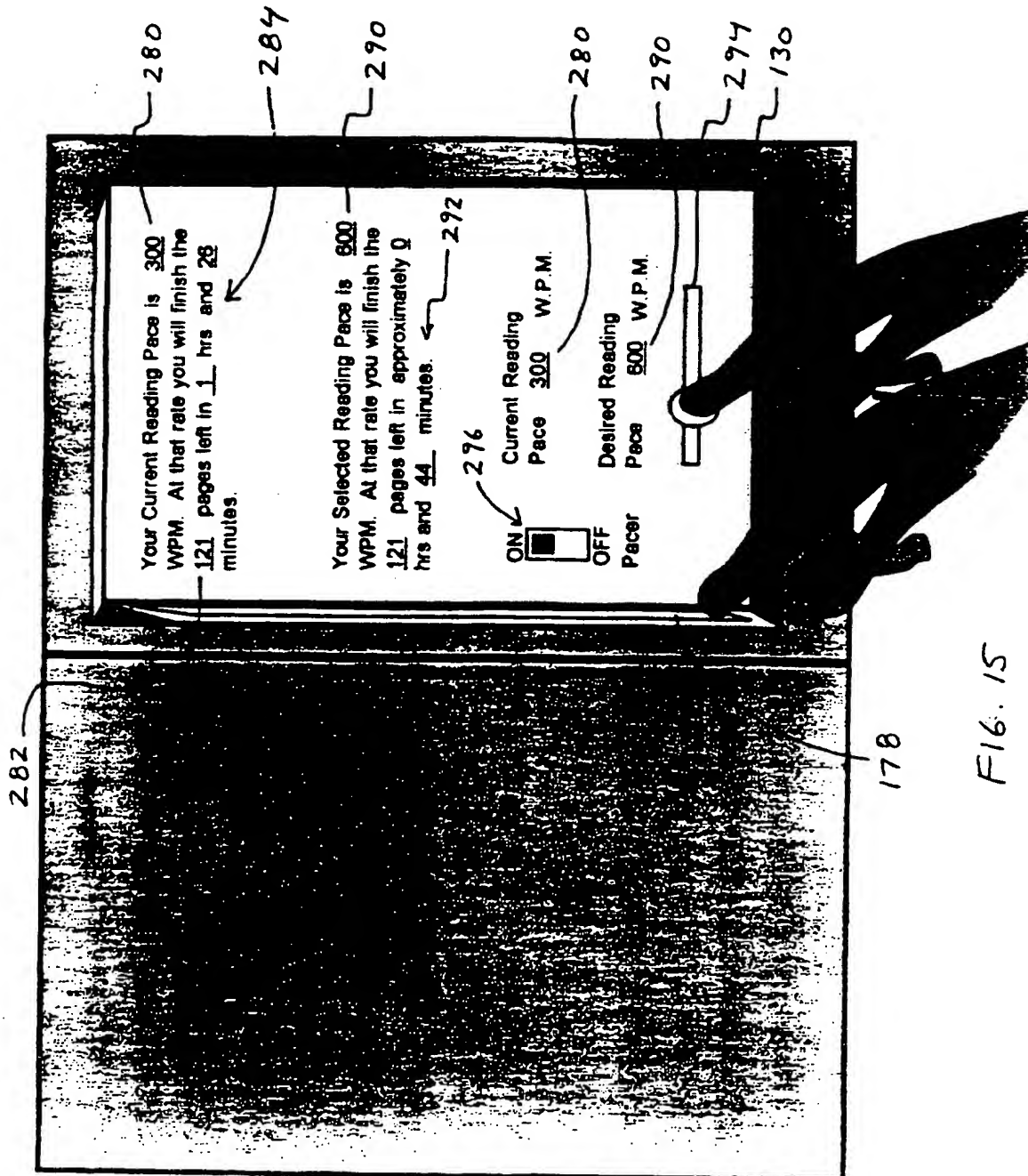


FIG. 15

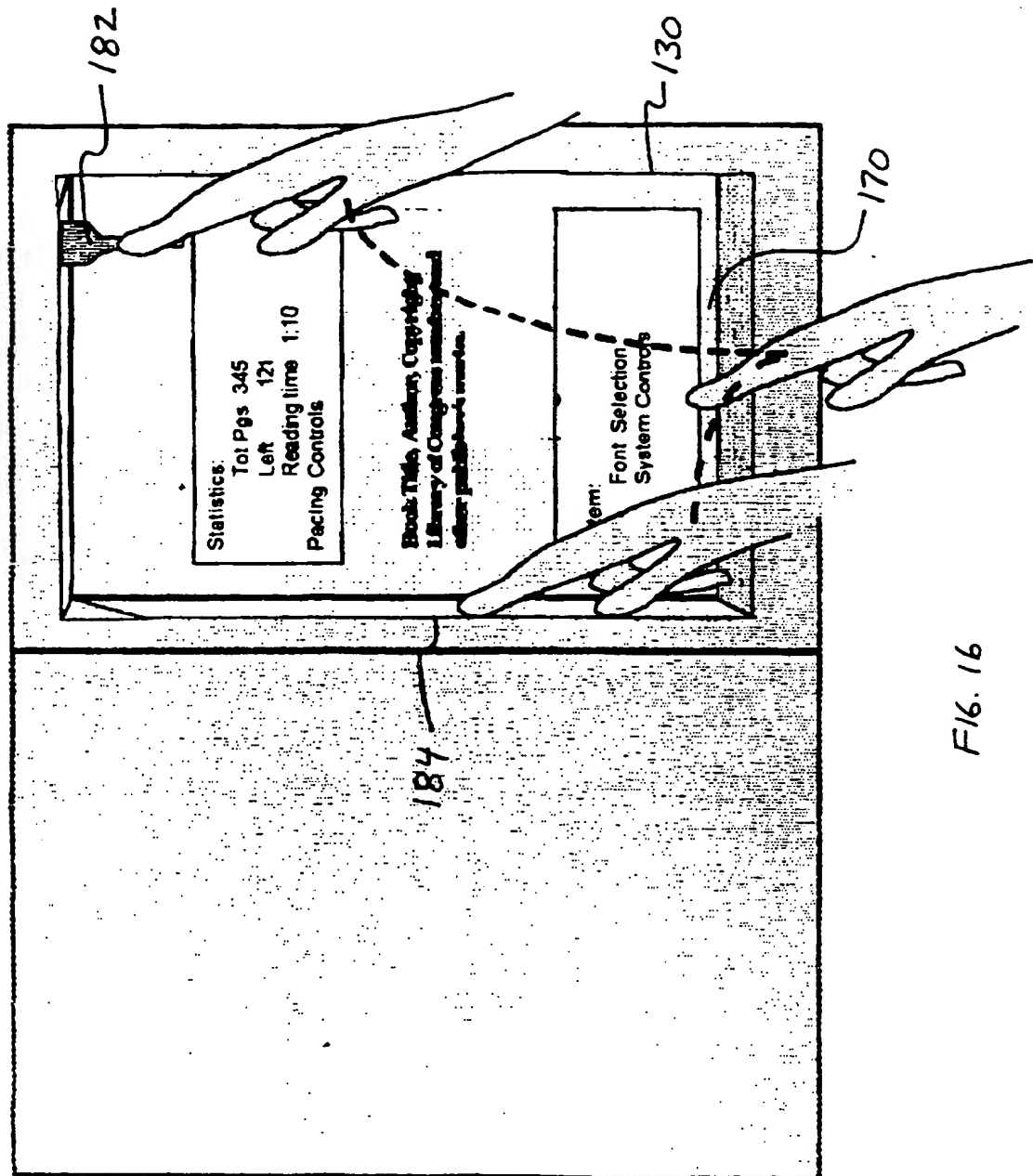
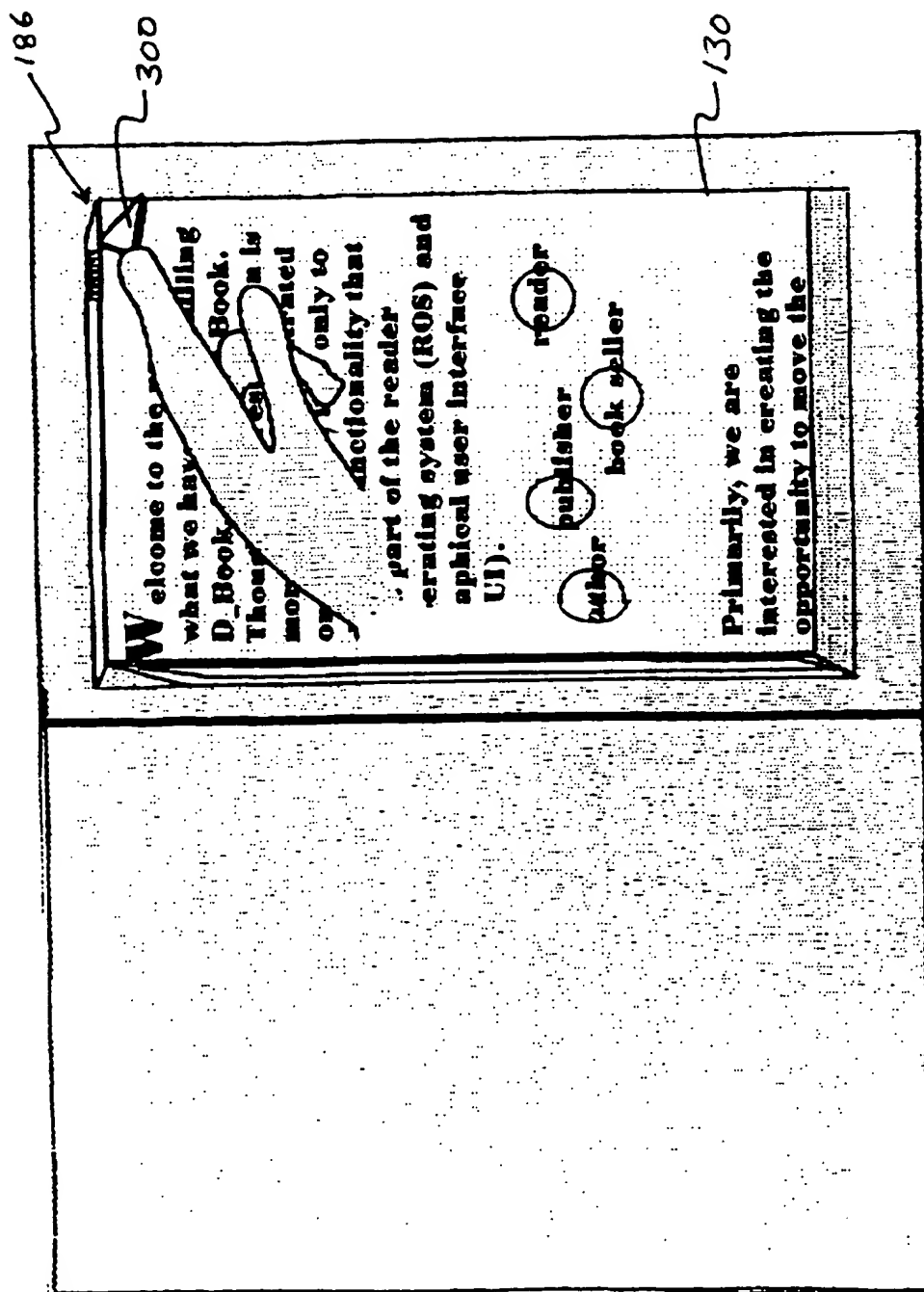


FIG. 16



F16.17

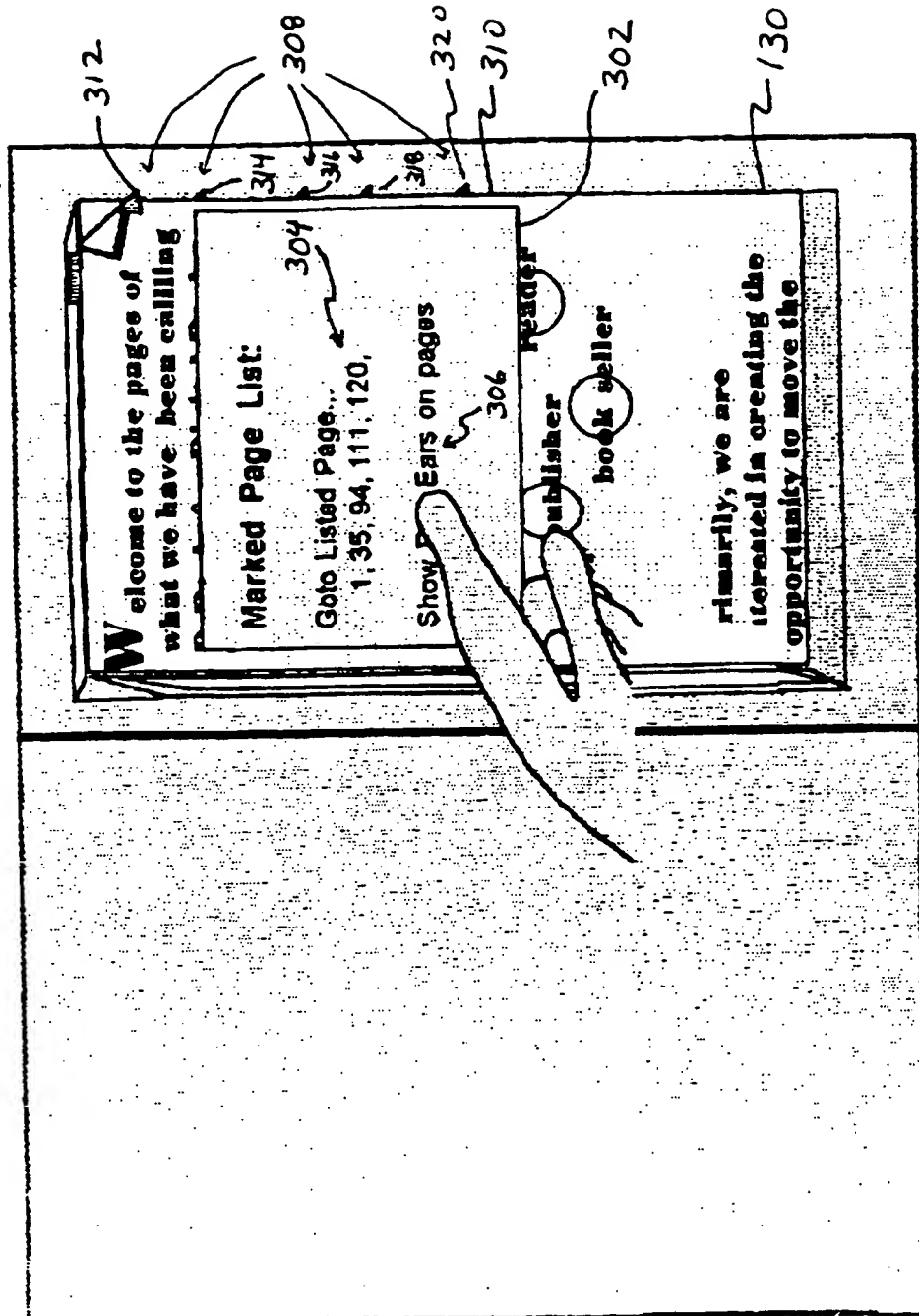


FIG. 18

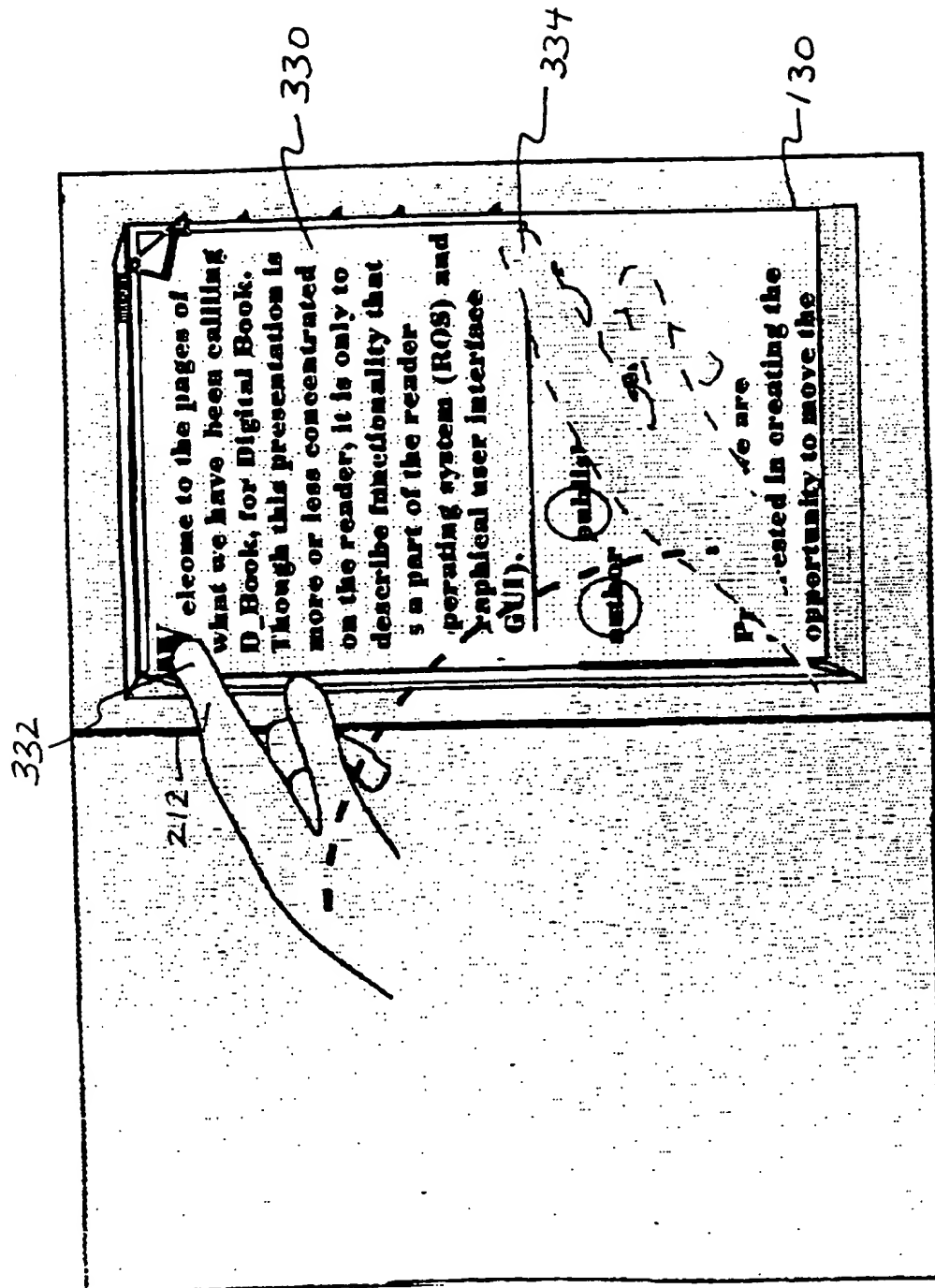


FIG. 17

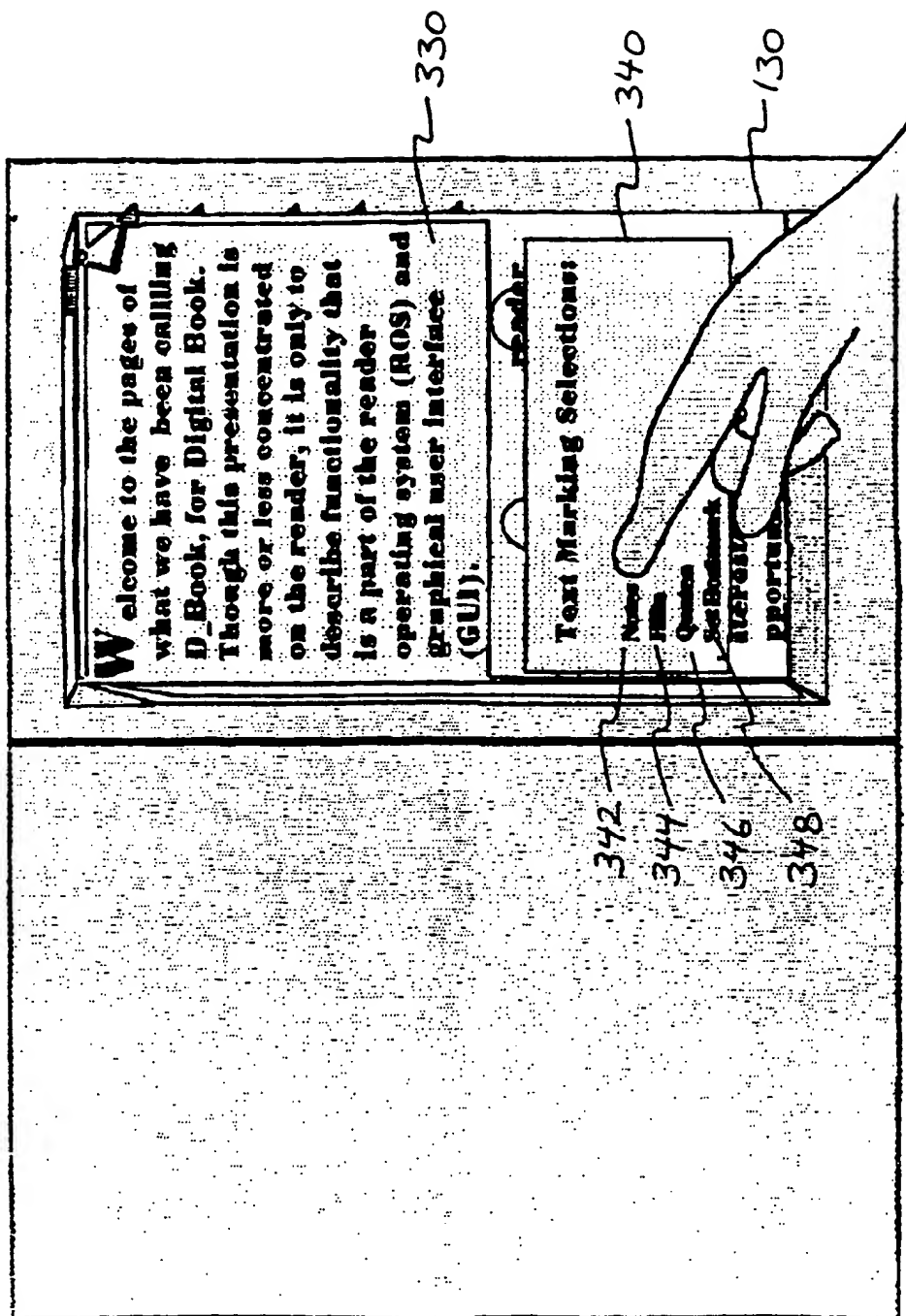


FIG. 20

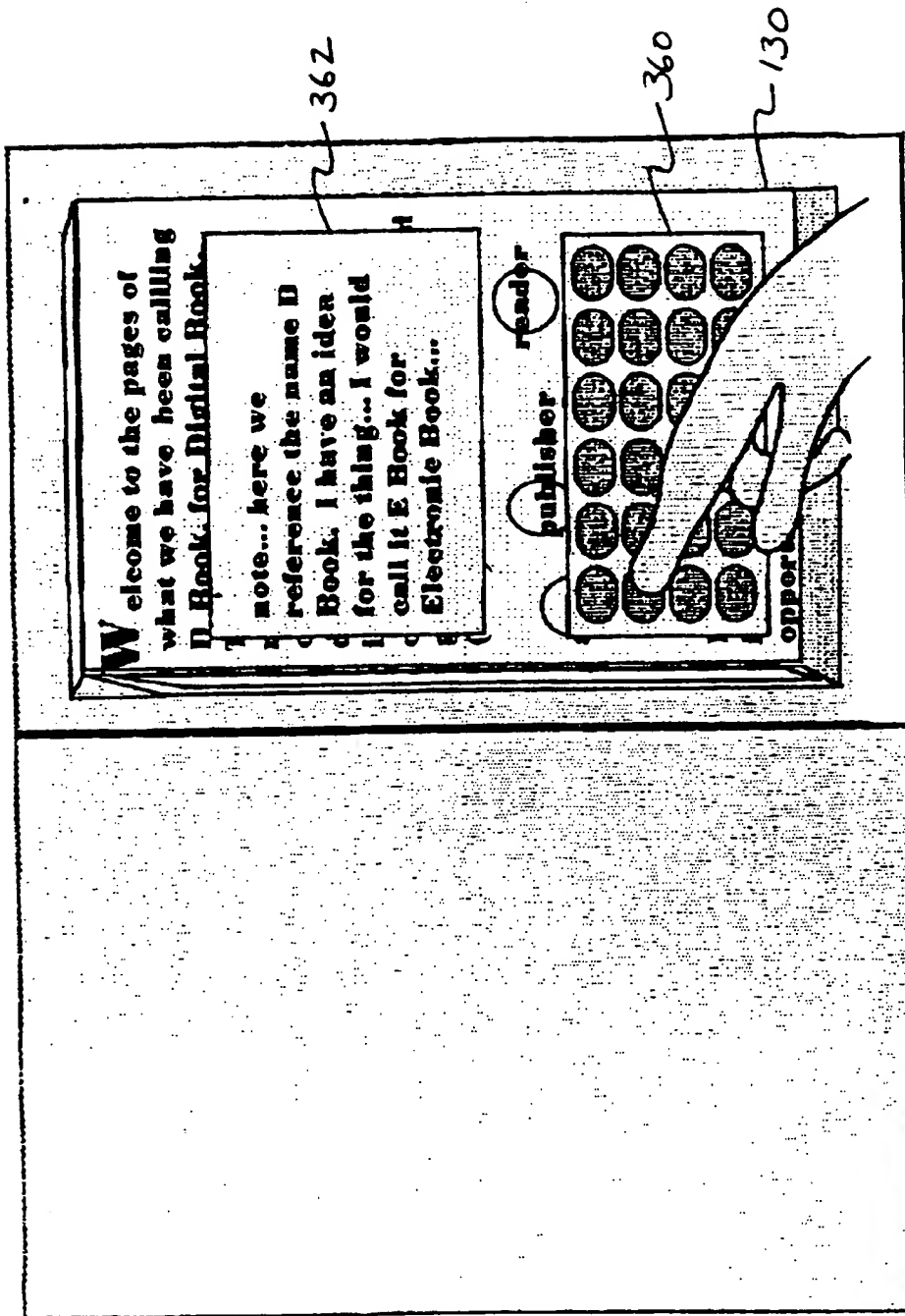


FIG. 21



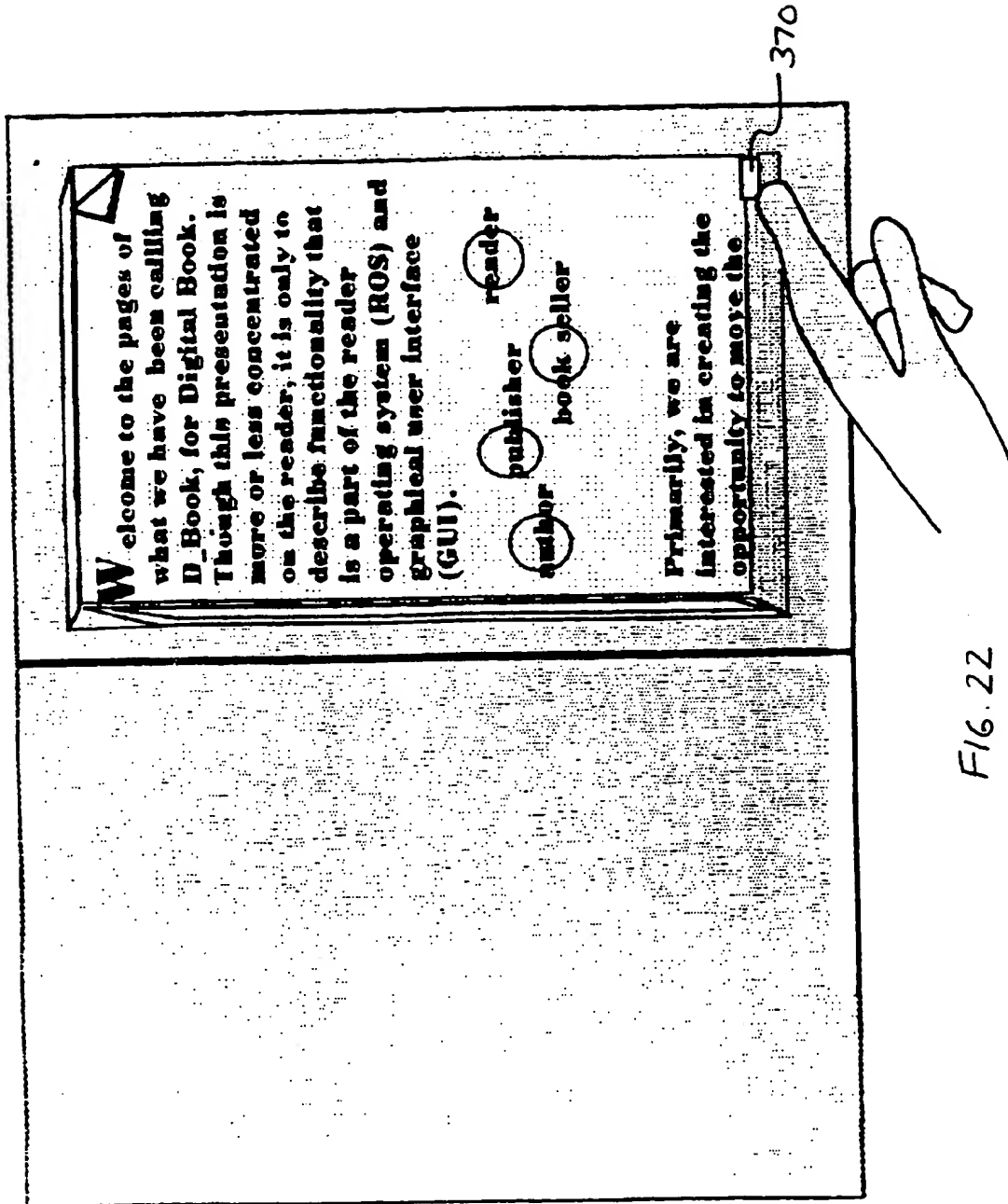


FIG. 22

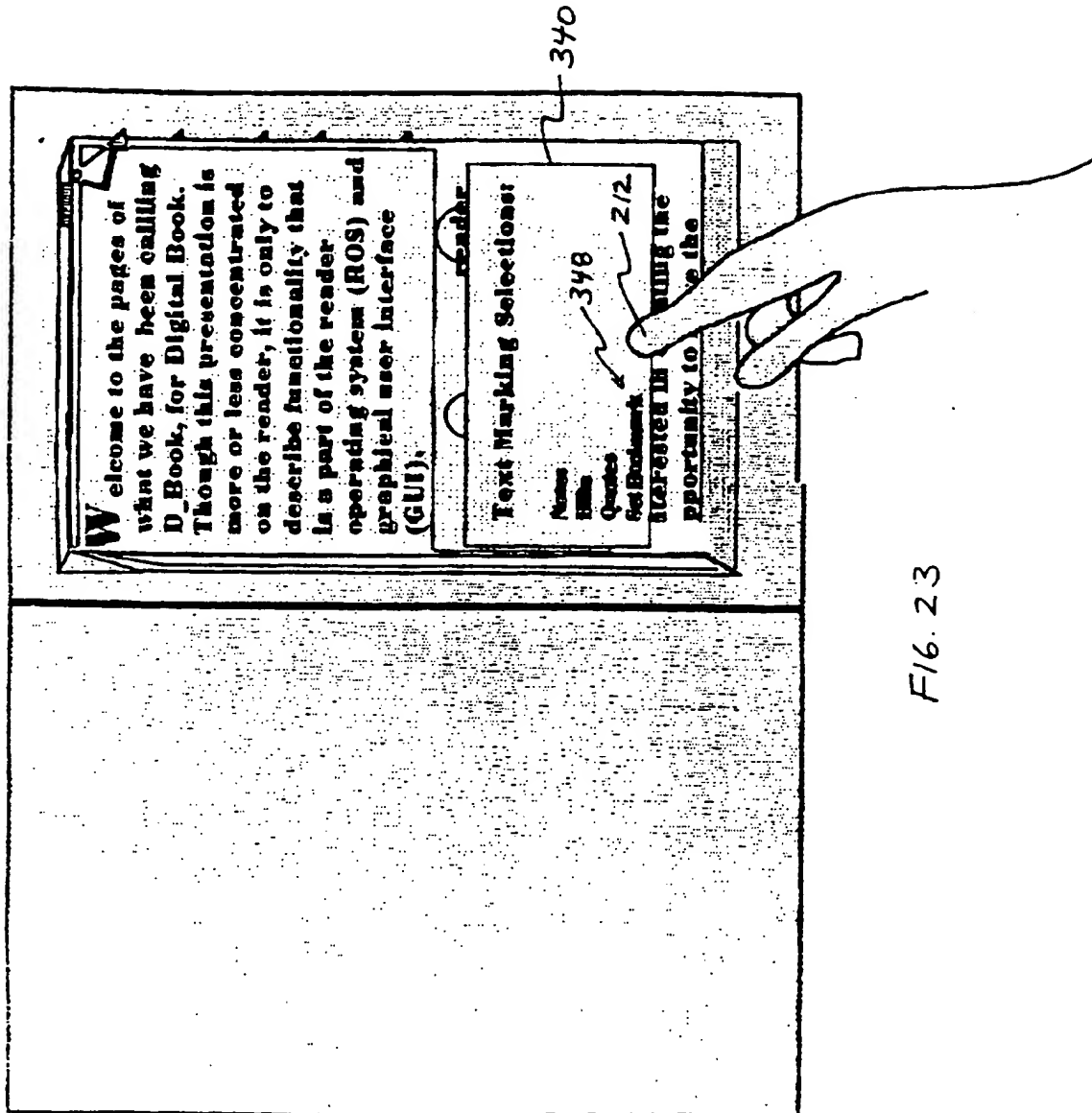


FIG. 23

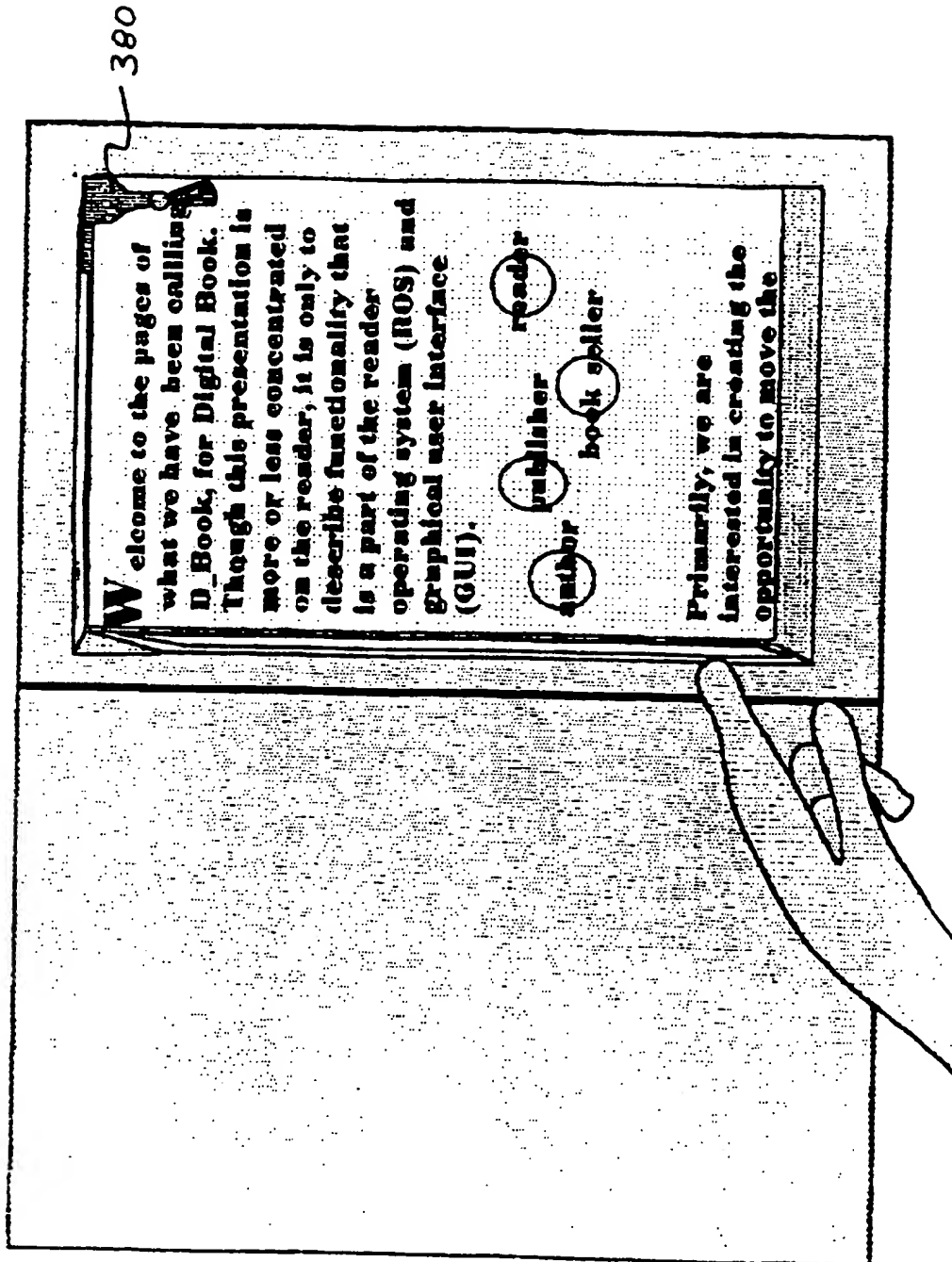
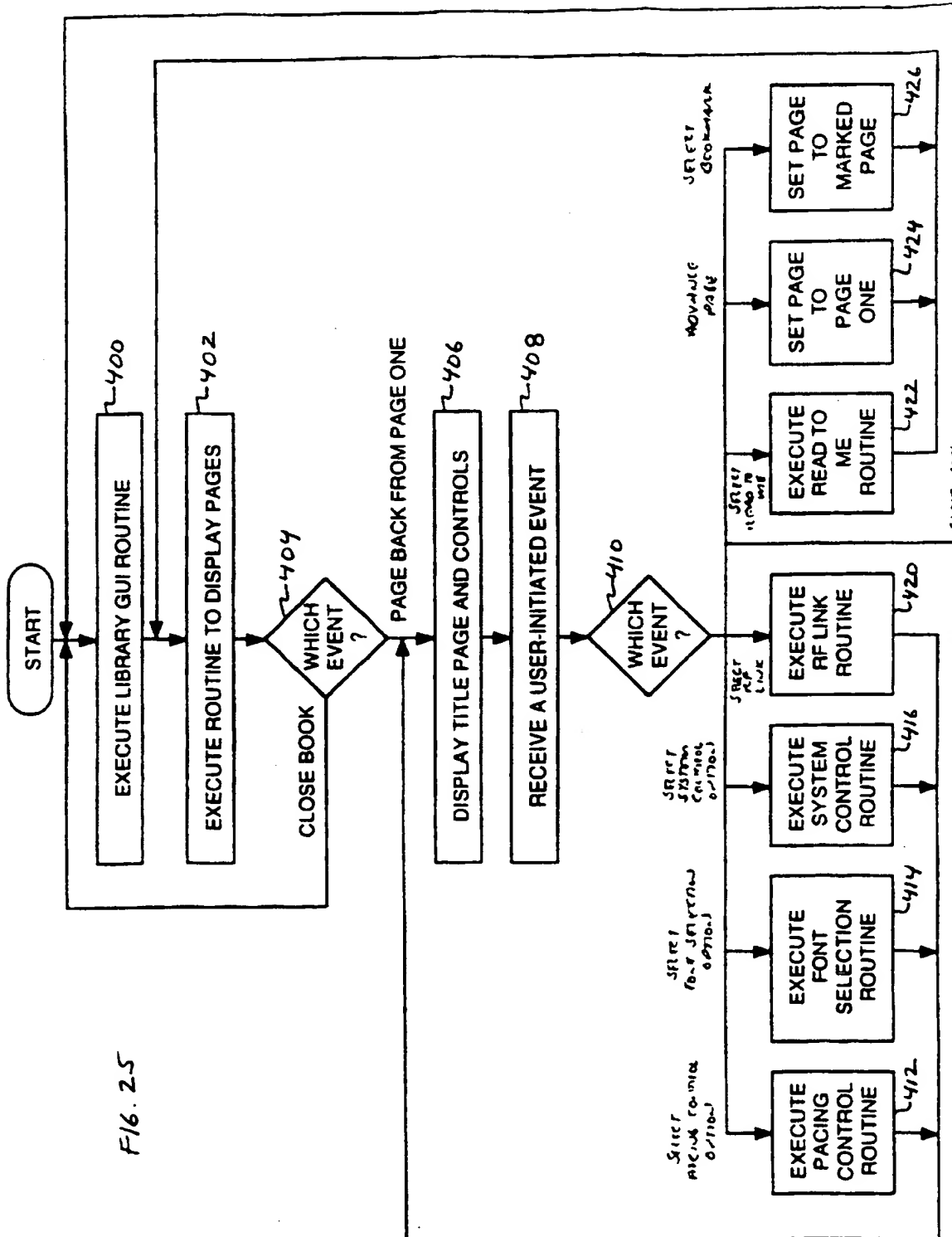


Fig. 24



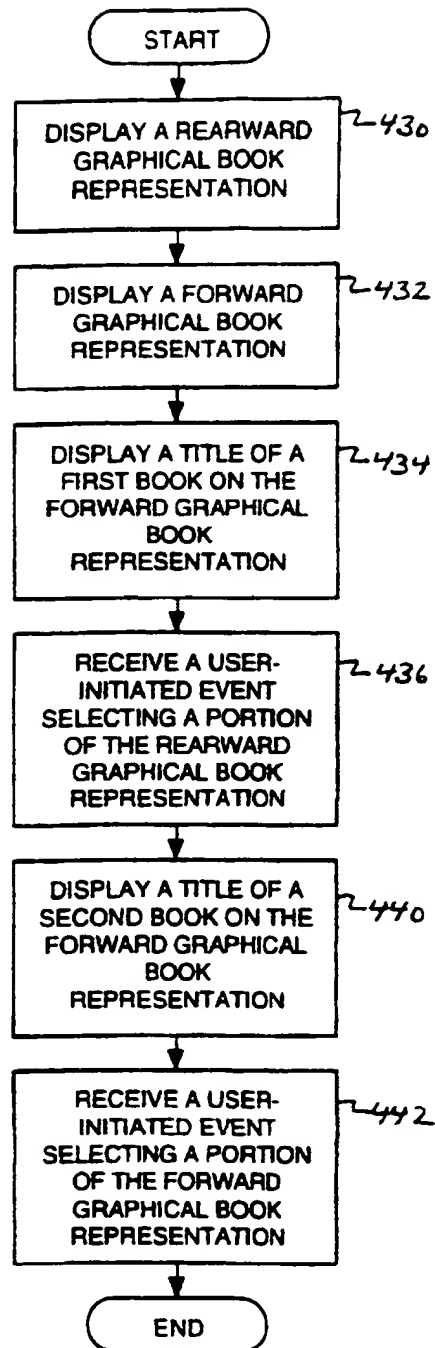
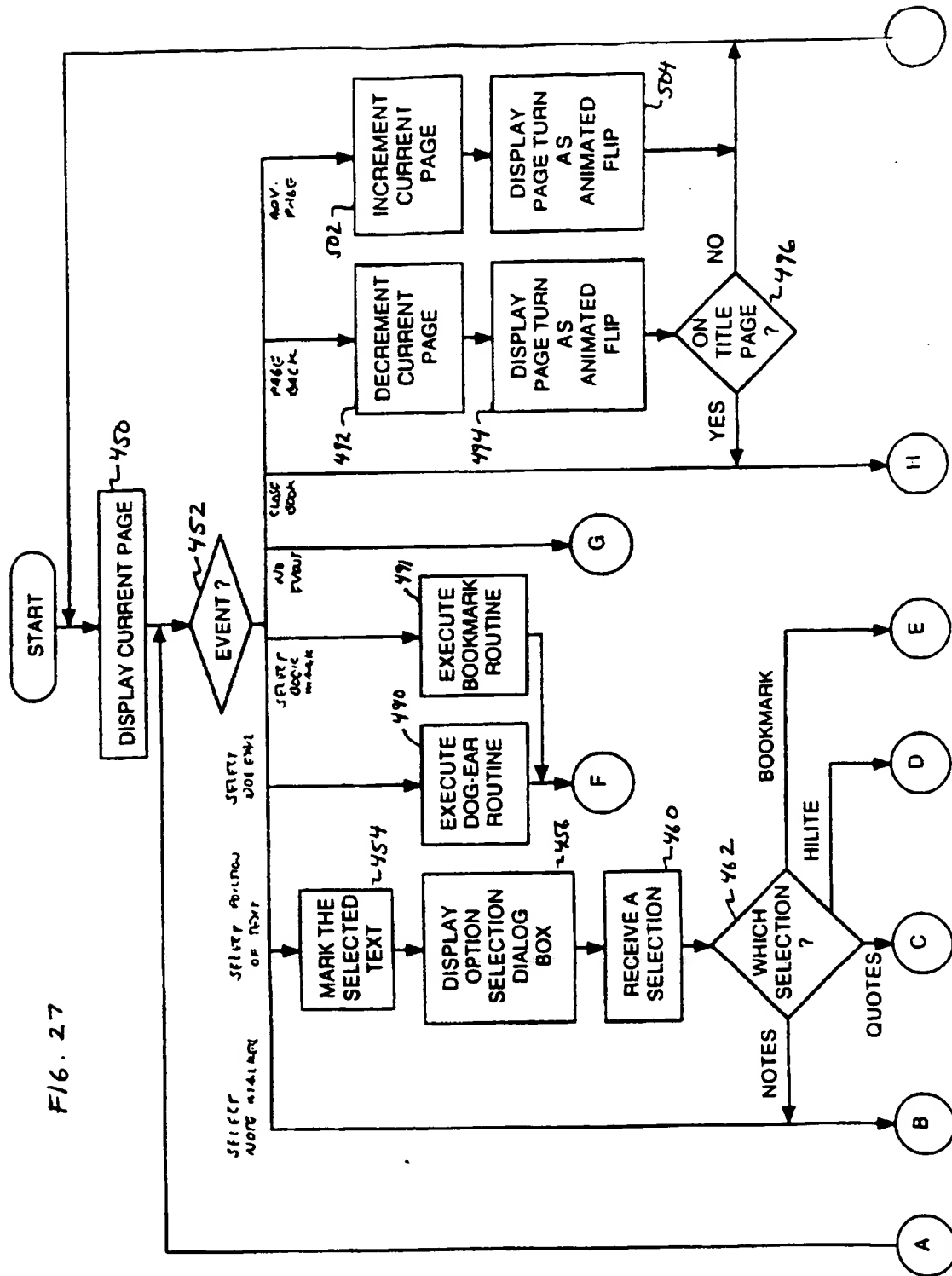


FIG. 26



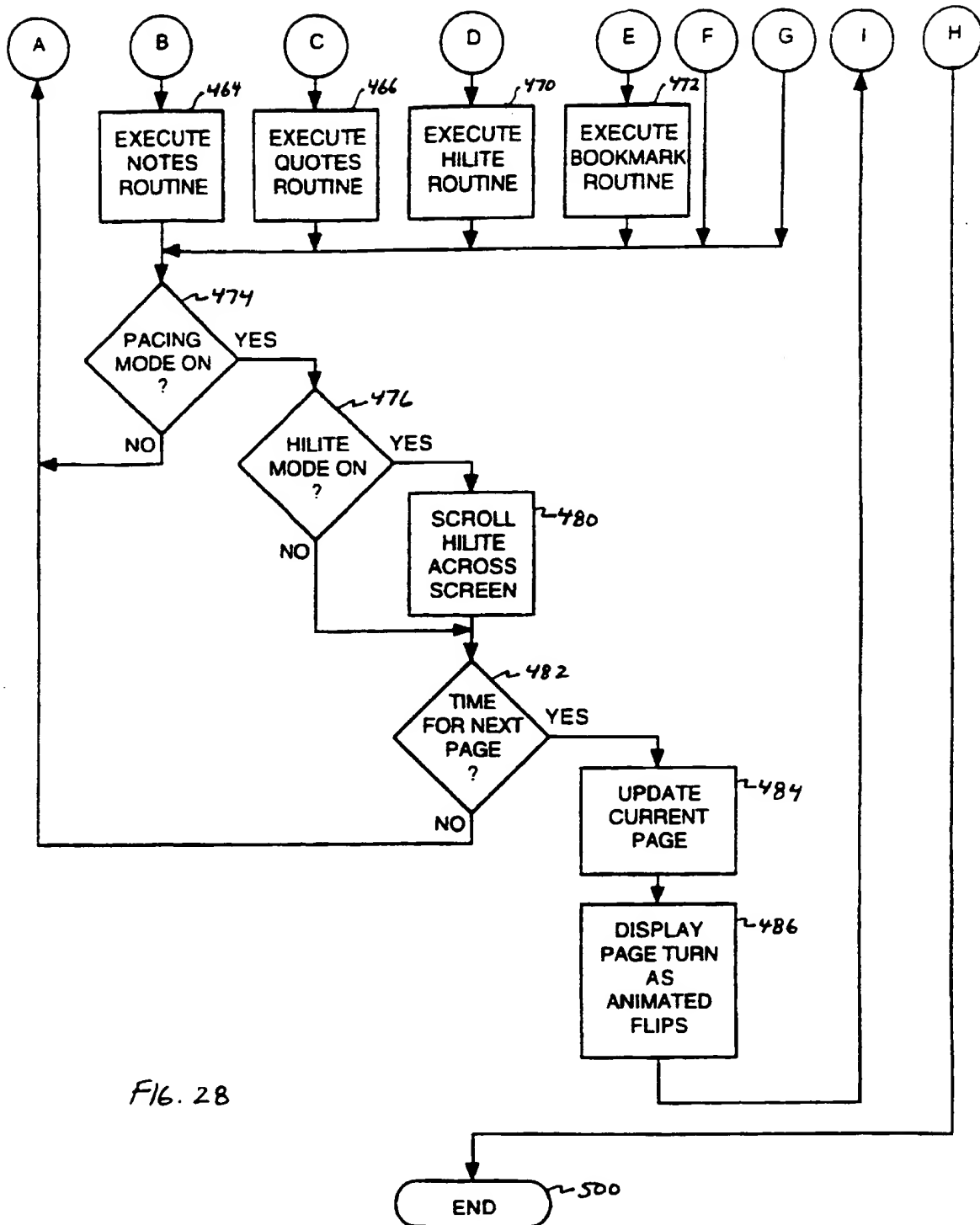
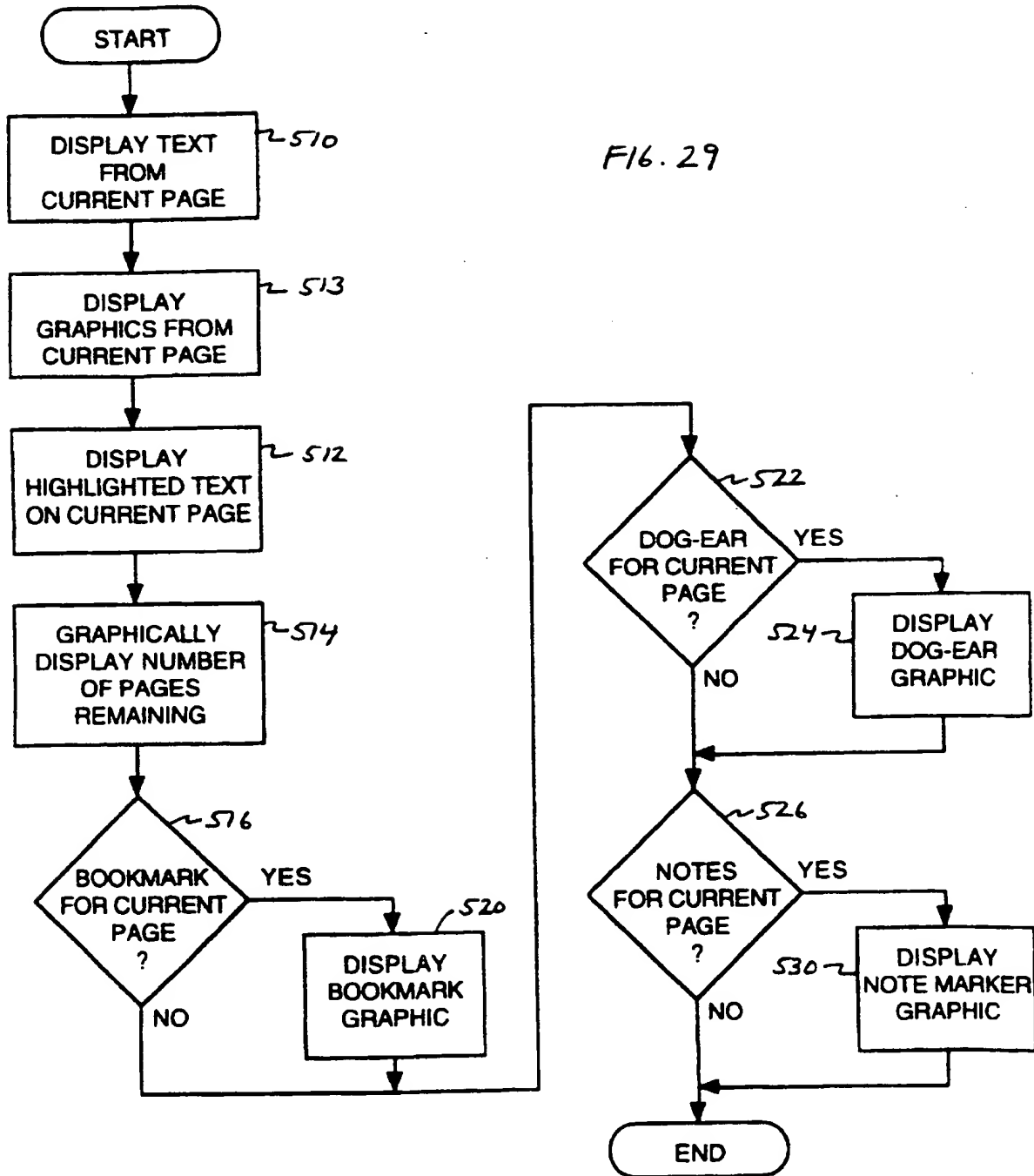
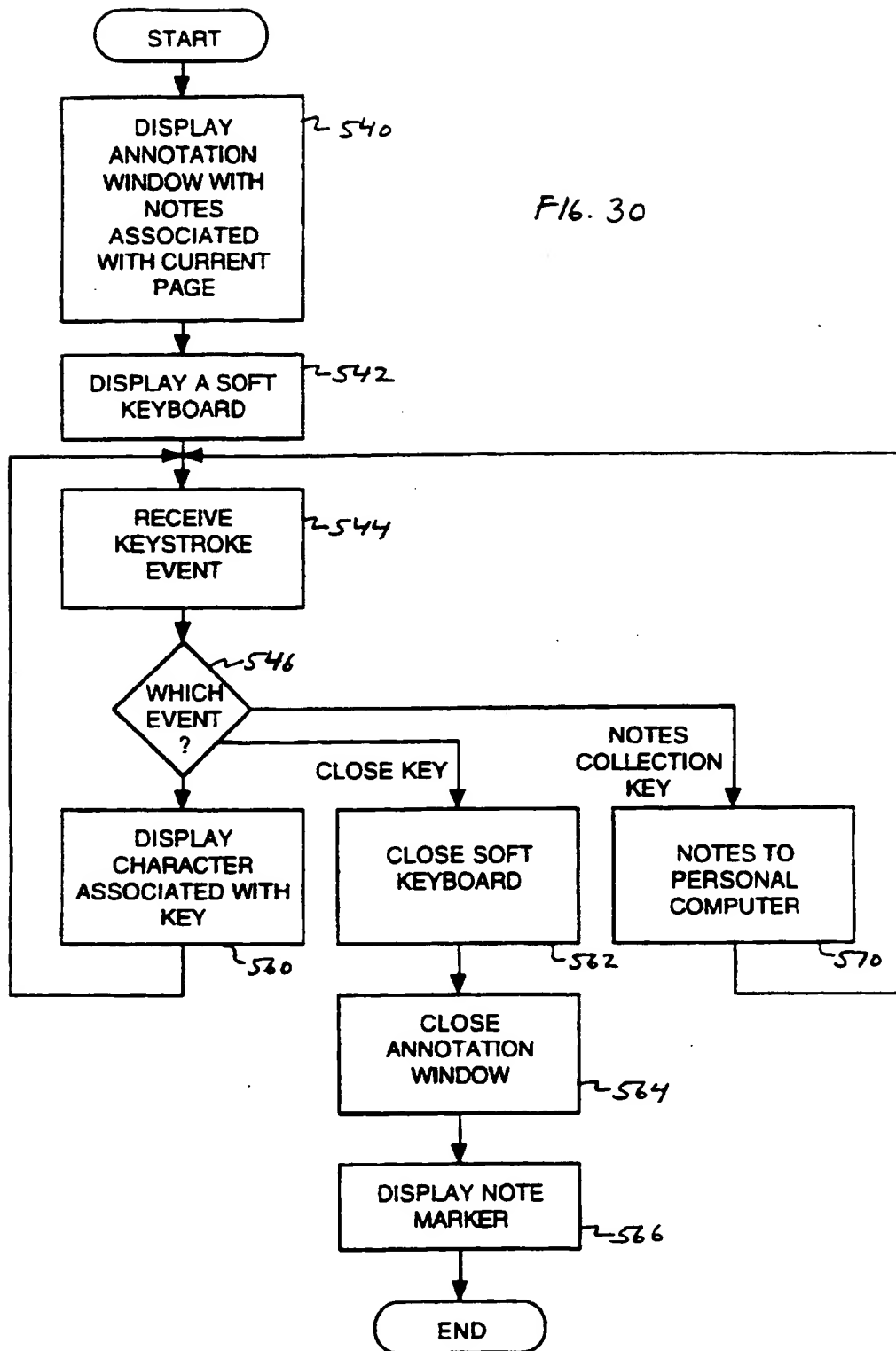


Fig. 28







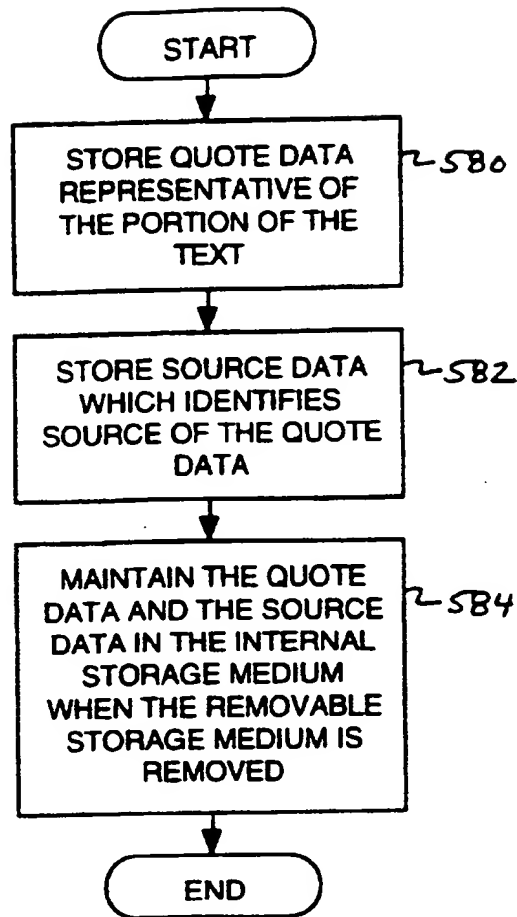
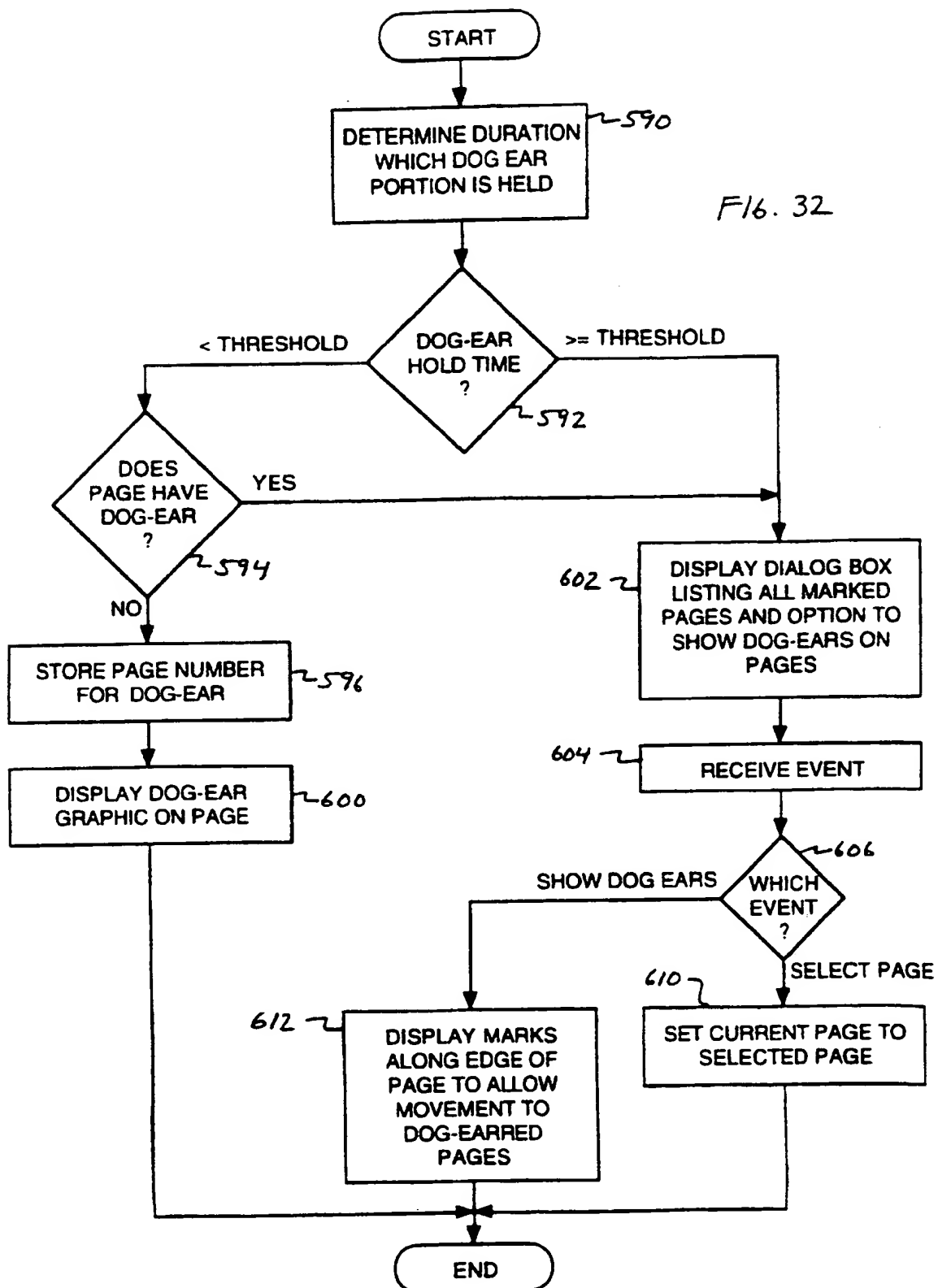
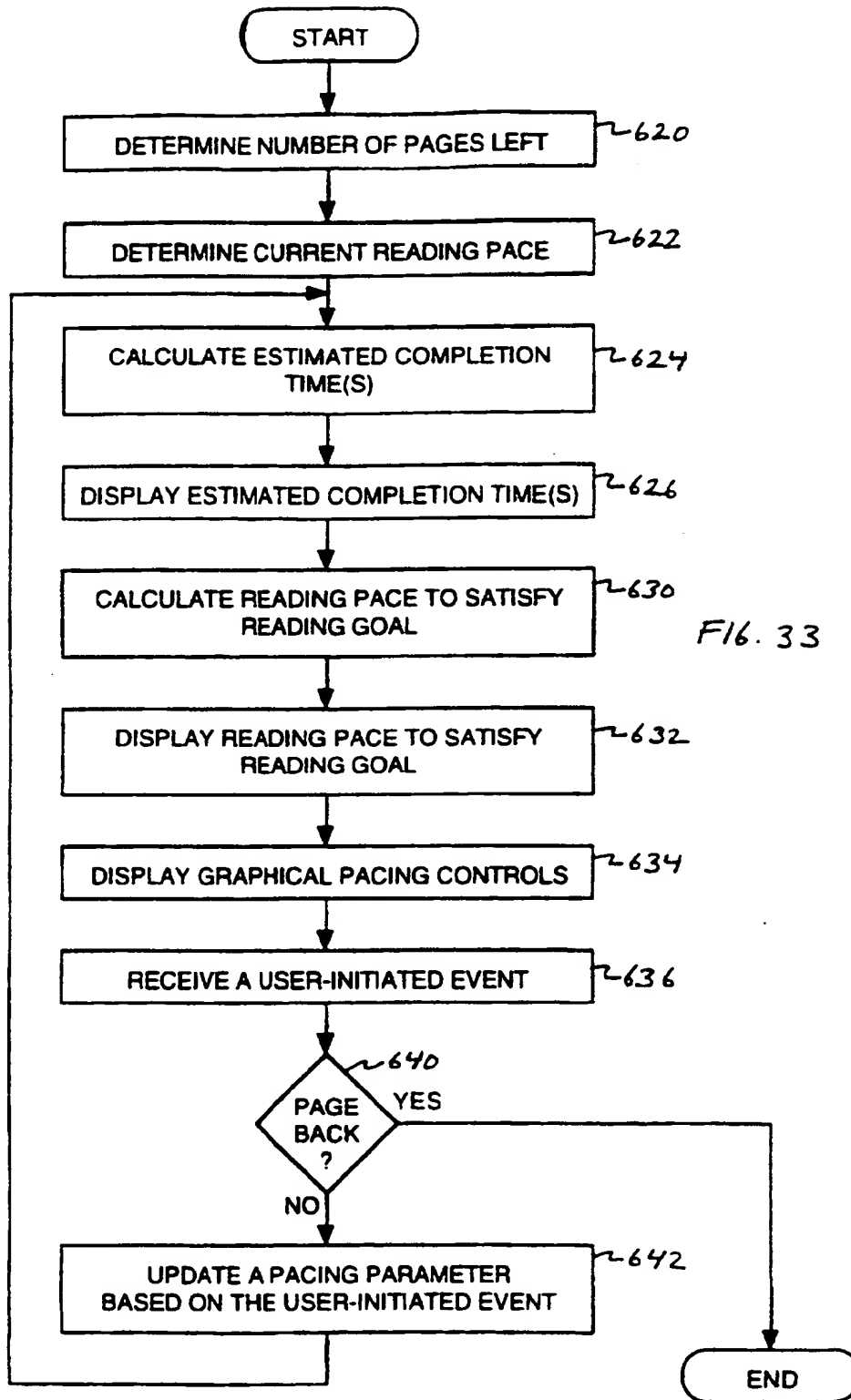
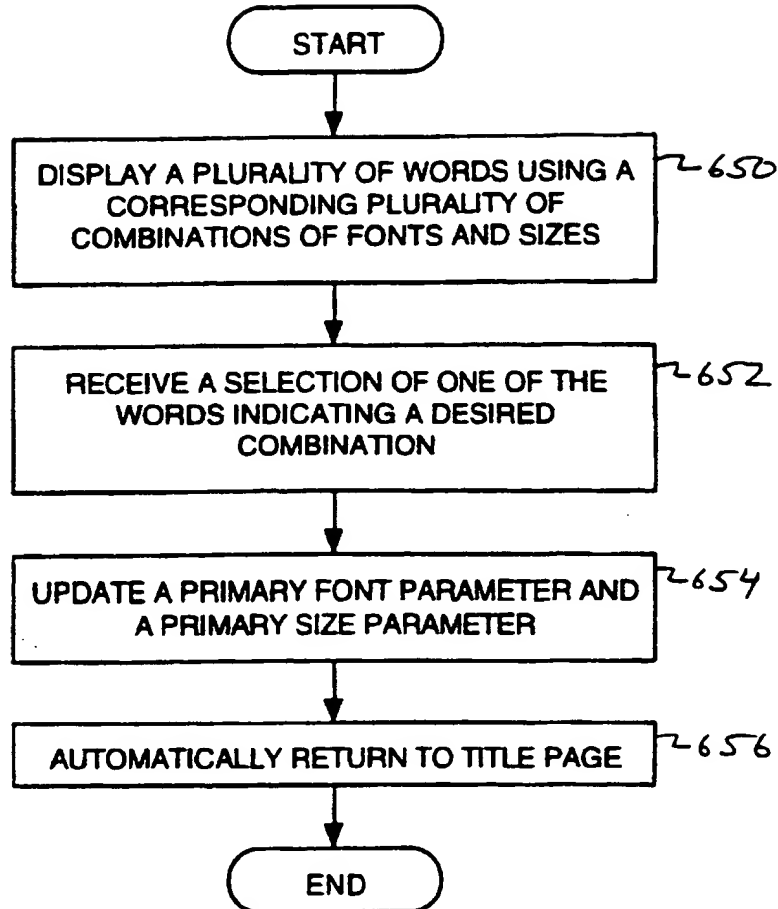


FIG. 31







F16. 34

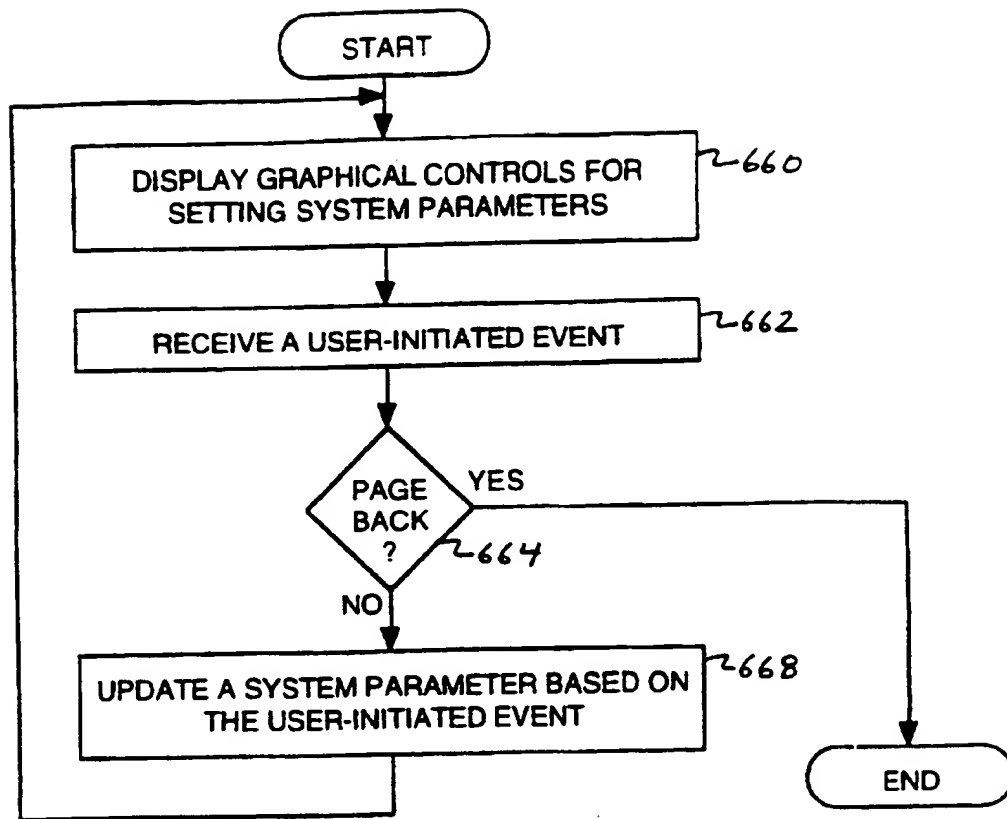


FIG. 35

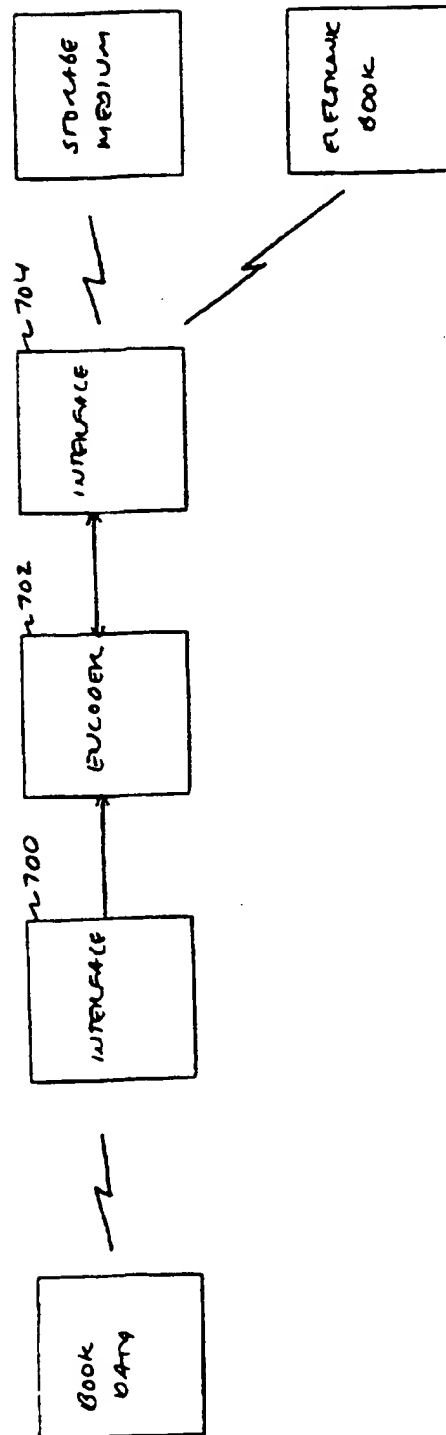


FIG. 36

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US96/19701

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06F 17/22

US CL : 395/760, 761

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/760, 761, 600; 382/13, 59; 380/4, 25

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,661,976 (BASCH) 28 April 1987, column 4, line 27 to column 6, line 6.	1
Y	US, A, 4,528,643 (FRENEY, JR.) 09 July 1985, column 5, line 50 to column 25, line 54.	1, 3, 6-10
A,P	US, A, 5,524,201 (SCHWARTS ET AL.) 04 June 1996, column 8, line 9 to column 10, line 41.	1-6
Y	US, A, 5,239,540 (ROVIRA ET AL.) 24 August 1993, column 5, line 60 to column 10, line 4.	1-6
Y	US, A, 4,985,697 (BOULTON) 15 January 1991, column 19, line 32 to column 20, line 20.	2, 7-10

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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*A* document defining the general state of the art which is not considered to be of particular relevance	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*E* earlier document published on or after the international filing date	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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*O* document referring to an oral disclosure, use, exhibition or other means	*Z* document member of the same patent family
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

26 FEBRUARY 1997

Date of mailing of the international search report

16 APR 1997

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/19701

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,239,665 (TSUCHIYA) 24 August 1993, column 5, line 44 to column 7, line 9.	1-6